SOUND IDEAS

Does Julian Hirsch Have a Tin Ear? • ESS Takes the Heil Road • Why BBN Has Good Vibes • Can Stereo Mags Test Speakers Accurately? • Citizens Band on the Run • A Roundup of New Products

Section One

Magazine Supplement to

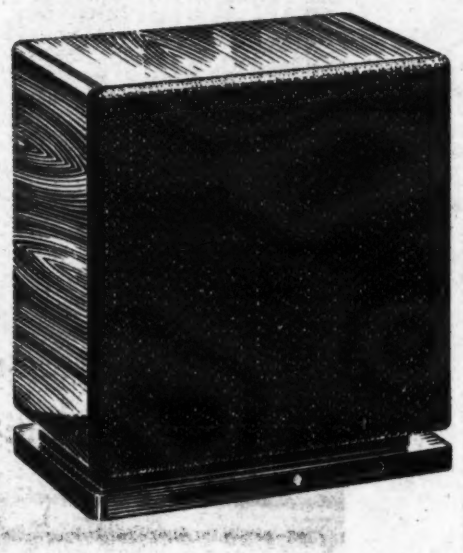
The Boston Phoenix

Jerry Bernat

•JENNINGS RESEARCH

CONTRARA GROUP

Contrara P
$225



Contrara S
$125

Contrara R
$125

A tribute to appreciation.

The Contrara Group. They are a tribute to your appreciation. A fulfillment that can only come from experiencing the latest in technology combined with the visual beauty of contemporary Italian design and craftsmanship. Two bookshelf size models and a rotating floor standing pedestal model. Loudspeakers for those who have the sensitivity and taste to appreciate a true work of art. From Jennings Research.

AUDIO LAB
9 Roxbury Street
Keene, New Hampshire 03431

CAMPUS HIFI
106 Market Street
Manchester, New Hampshire 03101

COPLEY CAMERA & HIFI
480 Boylston Street
Boston, Mass. 02116

LISTENING POST (ED'S TV)
1300 Park Avenue
Woonsocket, Rhode Island 02895

SOUND CELLAR DIV OF HAWKES TV SALES & SERVICE
U.S. Route 302
Westbrook, Maine 04092

MINUTEMAN RADIO
30 Boylston Street
Cambridge, Mass. 02138

MINUTEMAN RADIO
406 Essex St.
Lawrence, Mass.

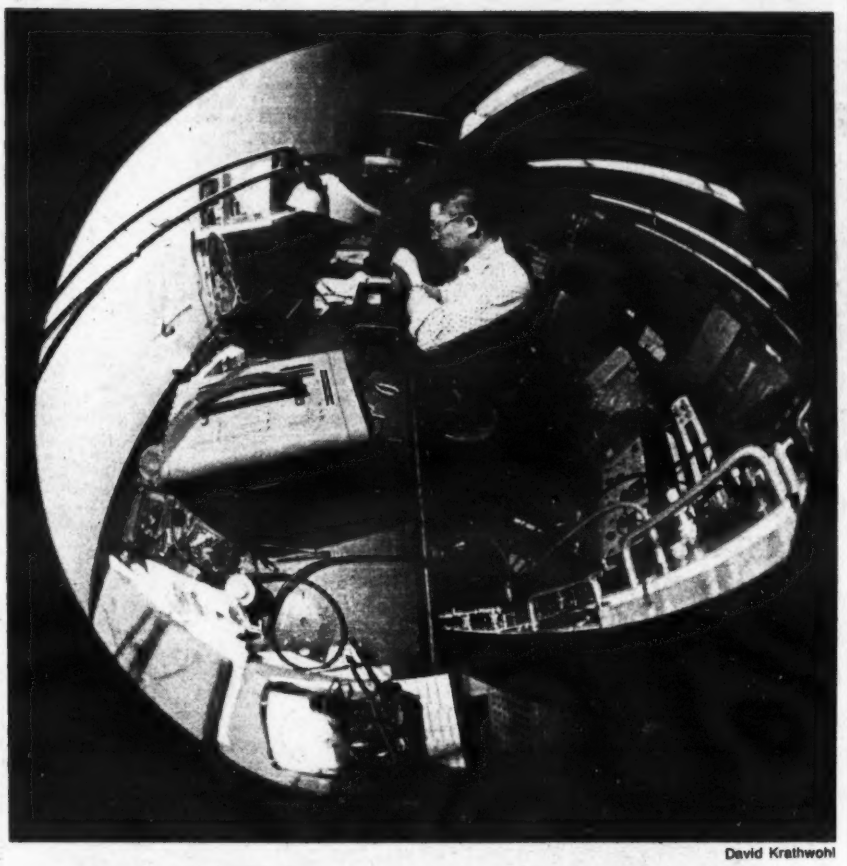
ODYSSEY SOUND, LTD.
542 John Fitch Highway
Fitchburg, Mass. 01420

TECH HIFI
Hanover Plaza
Hanover, Mass. 02339

TECH HIFI
375 North Montello
Brockton, Mass. 02401

SOUND SMITH
242 State Street
Portsmith, New Hampshire 03103

STROMBOLI ENTERPRISES
180 Lisbon Street
Lewiston, Maine 04240



David Krathwohl

SOUND IDEAS

(Section One)

4 **Does Julian Hirsch Have Double Hearing?**/Peter W. Mitchell
6 **Do Hi-Fi Mags Test Speakers Accurately?**/Roy F. Allison
14 **BBN Has Good Vibrations**/Clif Garboden
22 **So What Else Is New?**
23 **Citizens Band on the Run**/Larry Collins
26 **ESS Takes the Hell Road**/John Schlafer

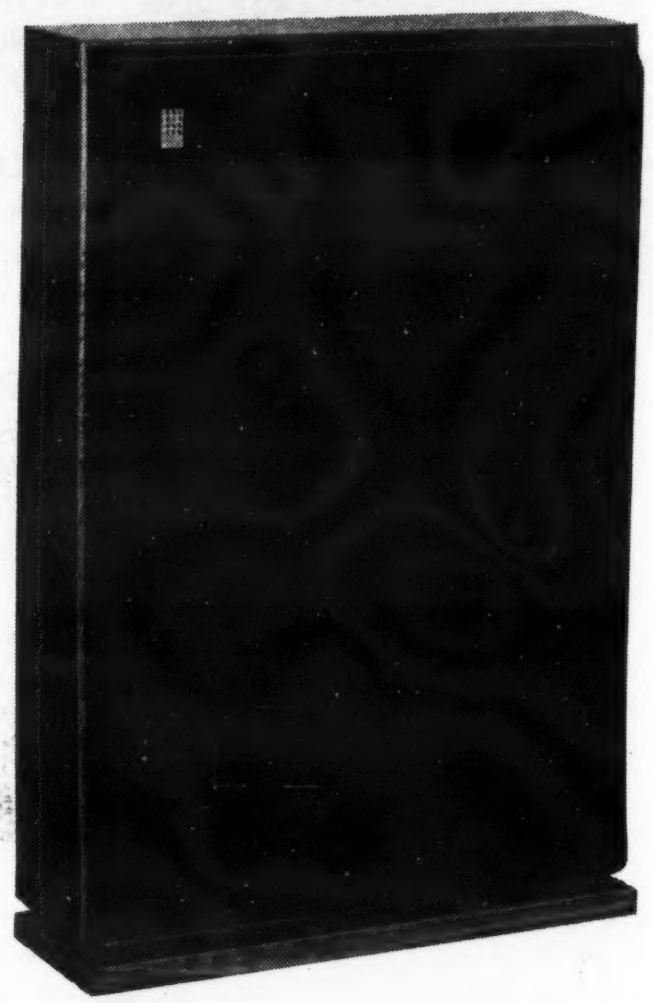
SOUND ADVICE

(Section Two)

3 **We Have Seen the Future**/Michael Riggs
4 **How to Make Your Own *Nutcracker Suite***/Peter W. Mitchell
6 **Getting Your Kit Together**/James Brinton
16 **Accessories: A Feast for Sore Ears**/William A. Kanner
24 **Pressing Matters**/Michael Riggs
30 **The Groove Lube**/Peter W. Mitchell

On the cover: The mystifying photo is actually a composite shot consisting of a tweeter cone (the thing that looks like a grapefruit) and the heat vortex from a radiator (it's supposed to simulate the appearance of sound waves — get it?). Jerry Berndt did it for us, and he thinks it's swell.

Come hear the impossible dream.



The new Koss Model One full-range electrostatic speaker.

The Koss Model One is a patented 4-way electrostatic speaker that was designed and built to satisfy the highest levels of audio awareness. No other speaker in history can boast of as many design innovations and performance breakthroughs. No other speaker can reproduce the lowest to the highest octaves of music with the precision, naturalness and clarity of the Koss Model One Electrostatic Speaker. Come in and hear your dream come true.

You can hear the impossible dream at these selected dealers:

CONNECTICUT

AUDIOPHILE
231 Bedford Street
Stamford, Ct. 06902

SOUND GALLERY
47 Greenwich Avenue
Greenwich, Ct. 06830

STEREO LAB
158 Captains Walk
New London, Ct. 06320

STEREO LAB
Rt. 12, Sheetz Plaza
Groton, Ct. 06340

MAINE

POMERLEAU INC.
43 Bridge Street
Augusta, Me. 04330

MASSACHUSETTS

MINUTE MAN RADIO
30 Boyleston Street
Cambridge, Mass. 02138

NEW YORK

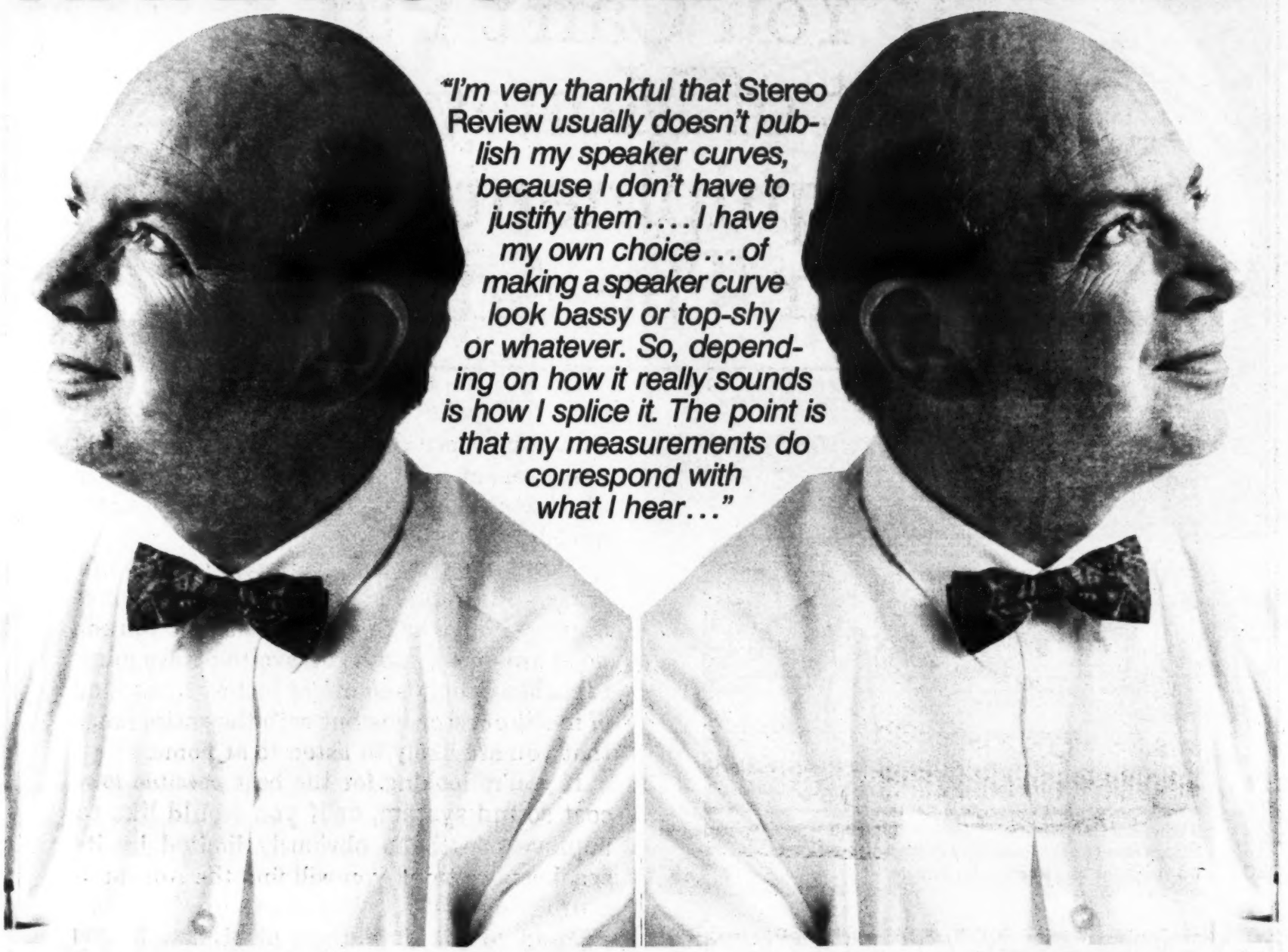
PAUL HEATH AUDIO
354 State Street
Rochester, New York 14608

STEREO EMPORIUM
3407 Delaware Avenue
Buffalo, New York 14217

KOSS® Model One electrostatic speaker

KOSS CORPORATION, 4129 N. Port Washington Ave., Milwaukee, Wisconsin 53212

DOES JULIAN HIRSCH HAVE DOUBLE HEARING?



"I'm very thankful that Stereo Review *usually doesn't publish my speaker curves, because I don't have to justify them.... I have my own choice... of making a speaker curve look bassy or top-shy or whatever. So, depending on how it really sounds is how I splice it. The point is that my measurements do correspond with what I hear..."*

by Peter W. Mitchell

Julian Hirsch is the dean of hi-fi product reviewers. He has been at it longer than any other (over 20 years); he garners more genuine respect from manufacturers for the soundness of his judgments than does any other reviewer, and his test reports are more widely read than anyone else's. They appear monthly in Stereo Review *and* Popular Electronics, *whose combined circulation (about 800,000) is greater than* all *of the other hi-fi mags' together.*

But if Hirsch is the most influential hi-fi reviewer, he is also the most passionately criticized — especially by dedicated audiophiles. He is damned for having a tin ear, for writing only favorable reviews and for being unable to distinguish between merely good products and first-class ones. Perhaps his greatest fault, in the view of audiophiles, is his custom of writing enthusiastic reviews of loudspeakers that the cognoscenti *disdain (notably the Bose 901, Heil AMT and Ohm F).*

Hirsch's breaking-in as a product reviewer happened on a strictly spare-time, amateur basis. While working as aerospace engineers in the 1950s, he and a colleague used their employer's lab equipment to test audio components on weekends. The wide disparity between manufacturers' claims and actual product performance stimulated them to publish the "Audio League Reports." One of the early reports covered the AR-1, the first acoustic-suspension loudspeaker; Hirsch recognized it as a breakthrough and reported that it had less bass distortion than many larger and more costly speakers. AR reprinted this review in full-page ads in national magazines, giving Hirsch a far wider exposure than the Audio League could have done, and his career was set. In the late '50s he wrote reviews for High Fidelity *and since the early '60s has been the exclusive reviewer for* Stereo Review.

Hirsch's test laboratory is in his home, located at a safe and comfortable 20-mile distance from the smog and seductions of Madison Avenue. He is cheerful, balding, 50-ish, with the height and build of a former football player. He is clearly an Establishment figure, on a first-name basis with most of the important people in the hi-fi industry, and is at once an enthusiast for good sound and a hard-headed skeptic about product claims.

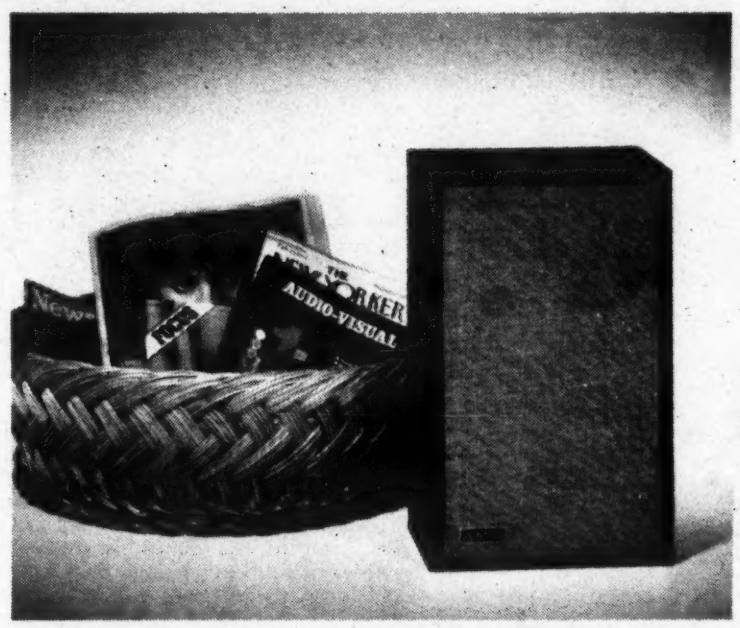
Perhaps because he felt relaxed in the cozily professional atmosphere of the Audio Engineering Society's convention, where this interview was taped in November for broadcast on Shop Talk, WBUR's Saturday morning aduio show, Hirsch described his methods and philosophy with surprising frankness. His comments will provide ammunition for both his detractors and his fans.

Boston Phoenix: There are striking differences in tone, style and content among the product reviews in the hi-fi magazines. To what extent are the differences due to deliberate choices in philosophy? Or are you really aiming your reviews at a different kind of reader — do you have a picture of the reader to whom you're aiming your review?

Julian Hirsch: Well, it's a very vague picture. First of all, probably, we at *Stereo Review* and *High Fidelity* are aiming our reviews at the same readership. *Audio* is certainly going for a more technical readership, so you would expect their approach to be different in detail, which it certainly is. In *Popular Electronics*, which is also one of our Ziff-Davis publications, there again it's a different readership, it's a general electronic readership, people who are interested in experimenting with home construction projects of any kind, and high fidelity may be only a secondary interest of theirs. In *Stereo Review* we're aiming at a very broad readership which varies in technical sophistication from a music lover who knows absolutely nothing — may be fortunate in even being able to turn on his equipment — to some of the engineers and scientists who have really been the backbone of our industry. So, with that broad spectrum of readership, it's impossible, I think, to pitch a report in such a way that it will appeal to all segments of the readership, and I don't even try. I make a half-hearted effort by not getting too technical, because we don't want to turn off the sizable percentage of our readers who are not engineers. By the same token, I feel — and our reports reflect this — that the report should be based on objective fact to the greatest possible extent, and is therefore not a listening-in-the-home type of evaluation (unless it's of a product that simply can't be tested in any other way). So my general practice is to test objectively, in every way that I can, the performance of a product, and then to combine that with my use experience, using the product functionally, and listening to it if it's something intended to have listening characteristics, and boiling it all down to an overall appraisal of

Continued on page 10

If You Can't Put a Lot of Money Into Stereo Equipment, Be Sure To Hear The Advent/3.



If your budget for a complete stereo system won't stretch very far past $300 (and can go that far only if you're sure of a long-term investment in something good), the Advent/3 can make an all-important difference in your enjoyment.

The limit on the sound of most low-cost component systems is the speaker. Often that speaker is a "house brand" designed mainly (or solely) for a cost low enough to allow a store to offer a good name-brand receiver and record player in a low-cost system.

The result is that most low-cost systems don't really have the kind of sound that people identify with component audio equipment.

The Advent/3 changes that. For roughly $50*, it offers sound that's very much like our more expensive speakers'. (Which is as it should be, since there's no reason why a low-cost speaker has to sound like a poor cousin of the same company's more expensive models.)

The Advent/3 has accurate, convincing, truly wide-range sound. Its bass response comes within a half-octave of the best you can do at any price, and its octave-to-octave musical balance sounds right not just with one kind of music or recording but with the entire range that you are likely to listen to at home.

If you're looking for the best possible low-cost sound system, or if you would like to improve one that's obviously limited by its speakers, we think you will find the Advent/3 a unique product. The more you've been exposed to the limitations of other low-cost speakers, the more amazing we think you will find its performance.

Thank you.

MUSIC BOX
Wellesley
58 Central St.

TWEETER, ETC.
Boston
874 Comm. Ave.

Brockton
849 Belmont St.

Cambridge
102 Mt. Auburn Street

Chestnut Hill
The Mall

TECH HIFI
Boston
870 Comm. Ave.
240A Newbury St.

Cambridge
30 Boylston St.
182 Mass. Ave.

Dedham
Route 1

Framingham
Route 9

Stoneham
352 Main St.

Worcester
279 Main St.

Hanover
Hanover Plaza

Brockton
374 North Montello

*Suggested retail price, subject to change without notice.

Cabinet construction: Non-resonant particle board finished in walnut-grain vinyl.

© 1976, Advent Corporation

DO THE HI-FI MAGS TEST SPEAKERS ACCURATELY?

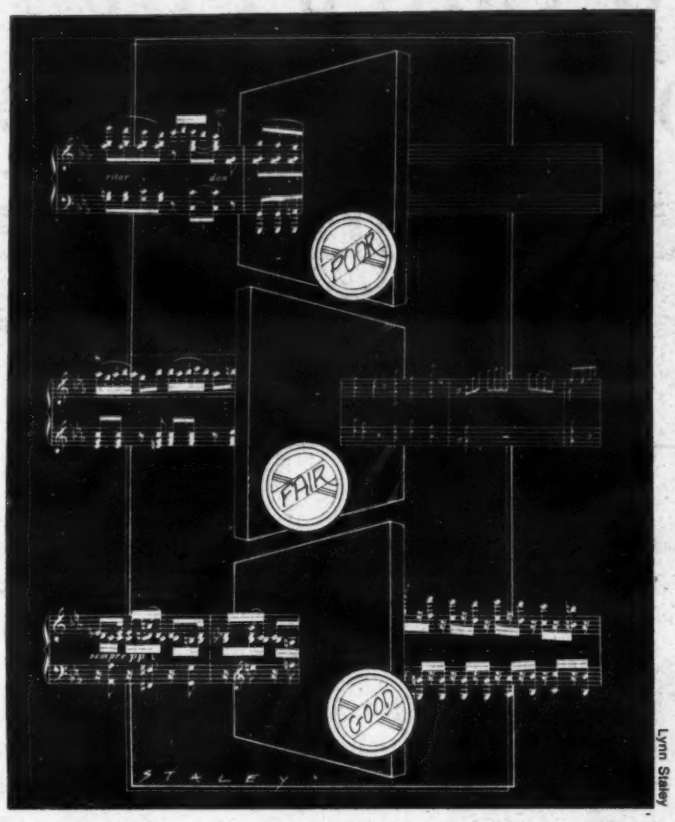
Putting product reviewers "in phase"

by Roy F. Allison

Q: *Do loudspeaker test reports have any information that a shopper would find useful?*
A: *Well, they're interesting, although a little hard to figure out, and there certainly is a lot of variety in . . .*

Q: *But are they useful? Do they help you to separate the good speakers from the not-so-good, or even the good from the bad?*
A: *A fair amount of the information is helpful, but much of it is useless or worse.*

Q: *Should I take that to mean that some reports contain information that can lead you to the wrong conclusions?*
A: *Not some — all of them do.*



Lynn Staley

It isn't easy to learn how to interpret published test data on an amplifier or a pickup cartridge, but, once you have learned, you can make comparisons based on performance results that (for the most part) are relevant to how the unit will do its job in real life. Many of the tests made on hi-fi components and reported in consumer publications are valid. Even if you don't understand the test data on an FM tuner, the person who wrote the report probably does know what they mean. If you read a sufficient number of his reviews you will crack his between-the-lines code; then at least you will have an idea of what he really thinks about it. There is a good chance that he will be right.

Unfortunately this isn't generally true of loudspeaker system reviews and reviewers. Input *vs.* output relationships for other high-fidelity components are fairly well understood; although there may be some quibbling on minor details, the significance of standard performance tests is generally accepted. For a loudspeaker system, on the other hand, the output is not an electric but an acoustic "signal." It issues into three-dimensional space and both its amplitude *vs.* frequency response and its time *vs.* frequency response change with the direction of radiation. Finally, its output is strongly influenced by its acoustic environment.

There is no consensus on what speaker measurements should be made, nor on an appropriate environment for the tests. Most of the tests that are made are, in fact, of marginal validity, and many of the report writers have only a dim understanding of what they mean. A few of them admit as much. Yet the tests continue; the results are published as if they really could predict the way speakers will perform in your living room. It is worth taking a look at how the Big Four magazines in this field test loudspeakers, while pointing out a few of the most conspicuous deficiencies.

Audio Magazine. The loudspeaker reviewer for *Audio* is Richard Heyser, one of the two earliest and most prominent advocates of the importance of phase response (the other is Denmark's Madsen). Heyser's tests are heavily weighted towards time phenomena, directionality, and measurement of "early" sound: measurements of the first few milliseconds of sound reaching a listener's ear, before the arrival of any room reflections. He emphasizes that he performs his tests in a real room, but employs very sophisticated test techniques (time-delay spectrometry and coherent signal processing) that virtually eliminate the influence of the room. In effect, his measurements are nearly the same as they would be if he used an anechoic chamber.

Heyser is so concerned with the early sound from a speaker that he makes no frequency response measurements other than at 0 degrees (on the frontal axis) and at 30 degrees off-axis. Thus, he tells you nothing about acoustic power output *vs.* frequency, which is of primary importance more than a few feet away from the speaker in a real room.

Heyser's distortion measurements are unusually detailed and certainly as valid as any. He gives complete impedance data, including a polar plot of reactance and resistance *vs.* frequency. You may appreciate that if you are designing a power amplifier to drive the speaker.

At the end of his report, Heyser gives you his listening test results. He does not dissemble. His subjective impressions undoubtedly are colored by what he thinks he *should* hear on the basis of his test results, but it is equally clear that he tries to put aside his biases — but he does speak his mind. This is undoubtedly the most valuable part of the review.

Consumer Reports. Consumers Union uses exceptionally sophisticated data-processing techniques in its speaker evaluations, too, but to a quite different purpose. The goal is to tell you nearly everything you need to know about a speaker system by means of one number: its "accuracy score." No one could quarrel with that aim.

CU considers power response — the acoustic power output *vs.* frequency — of a speaker system to be its most important attribute, with everything else of secondary importance. In this I believe the magazine's editors are right.

CU's measurement of power response is made in an anechoic chamber. This chamber has sound-absorbing material on all six room surfaces, so that no reflections can interfere with the direct sound from speaker to microphone. A speaker to be tested is rotated inside the chamber in a full circle, with stops every 10 degrees for a response curve. This is done with the cabinet resting on a long side and again with it resting on a short side, for a total of 70 individual response curves.

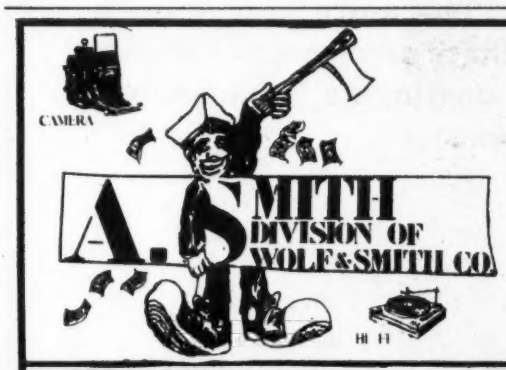
These curves are fed into a computer. The computer reads each curve to obtain its sound level by one-third-octave bands, then processes all the data to yield a curve of total acoustic power *vs.* frequency. Still not satisfied (because it knows that equal deviations in sound levels are not perceived as equal changes in loudness for all frequencies and at all absolute sound levels), CU's computer then performs the following steps:

1) It adjusts the overall level of the tested speaker's response curve to an arbitrary reference level of 85 dB SPL;

2) Within each one-third-octave band of frequency it assigns the proper value of sones (a unit of relative loudness) based on the tested speaker's relative output in that band. It does this by means of a table it has memorized;

3) Within each one-third-octave band, it then compares the sone value it has assigned the tested speaker to the sone value a "perfect" speaker (defined as one having perfectly flat acoustic power response) would have at the same overall reference level of 85 dB SPL. It divides the tested speaker's sone value by the reference value. Thus, a value of 1.0 indicates perfect match of test speaker to ideal speaker for that particular one-third-octave band. The larger the deviation from 1.0, the greater the audibility of the test speaker's departure from perfection in that frequency region. A value of 2 or 0.5 would indicate that the test speaker is twice as loud, or half

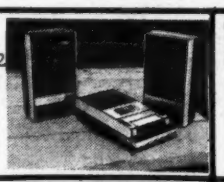
Continued on page 8



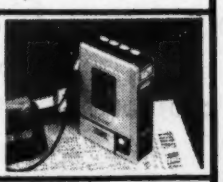
A Vote For Uncle Al Is A Vote For Low Prices!

SUPERSCOPE® MADNESS

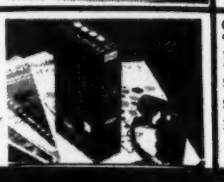
SUPERSCOPE CS-200S
Portable AC/DC Stereo Cassette Recorder with 2 external speakers and large carrying case
SALE **$149.95**



SUPERSCOPE C-106
Miniature Portable Cassette recorder with cue & review, built-in condenser microphone record level/ battery strength indicator
SALE **$77.95**



SUPERSCOPE C-108 DELUXE
Miniature Portable Cassette Recorder
Auto-Record Level, Auto Shut-Off,
Dual Differential
Flywheel Mechanism
SALE **$114.95**



SUPERSCOPE CR800
Portable AM/FM Radio Cassette recorder with sleep timer switch, speaker monitor, auto shut-off P.A./Play mix mode A.F.C. switch
SALE **$57.95**

CASH
MASTERCHARGE
OR BANKAMERICARD
(SORRY NO CHECKS)

A.S SMITH DIVISION OF WOLF & SMITH CO.

MON.-FRI.
OPEN 10: 10:30am-7pm
Sat. 10:30am-6pm

401 MASS. AVE. (CENTRAL SQUARE) CAMBRIDGE PHONE 876-3210

UNCLE AL GIVES YOU UP TO 50% OFF!

RECEIVERS	
Panasonic SA-50	149.95
EICO 3770	149.95
Superscope QRT 440	159.95
Superscope R-350	189.95
Hitachi SR-1100	349.95
Hitachi SR-301	189.95
Fisher 202	179.95
Pioneer 434	166.95
Sony STR 7065	394.95
Pioneer 535	209.95
Sherwood 7010	129.95
Sherwood 7110	159.95
Superscope R-330	149.95
Sony HQR 600	149.95
Sony 7055	319.95
Sony 7045	269.95
Sony 7035	229.95
Sony 7025	199.95

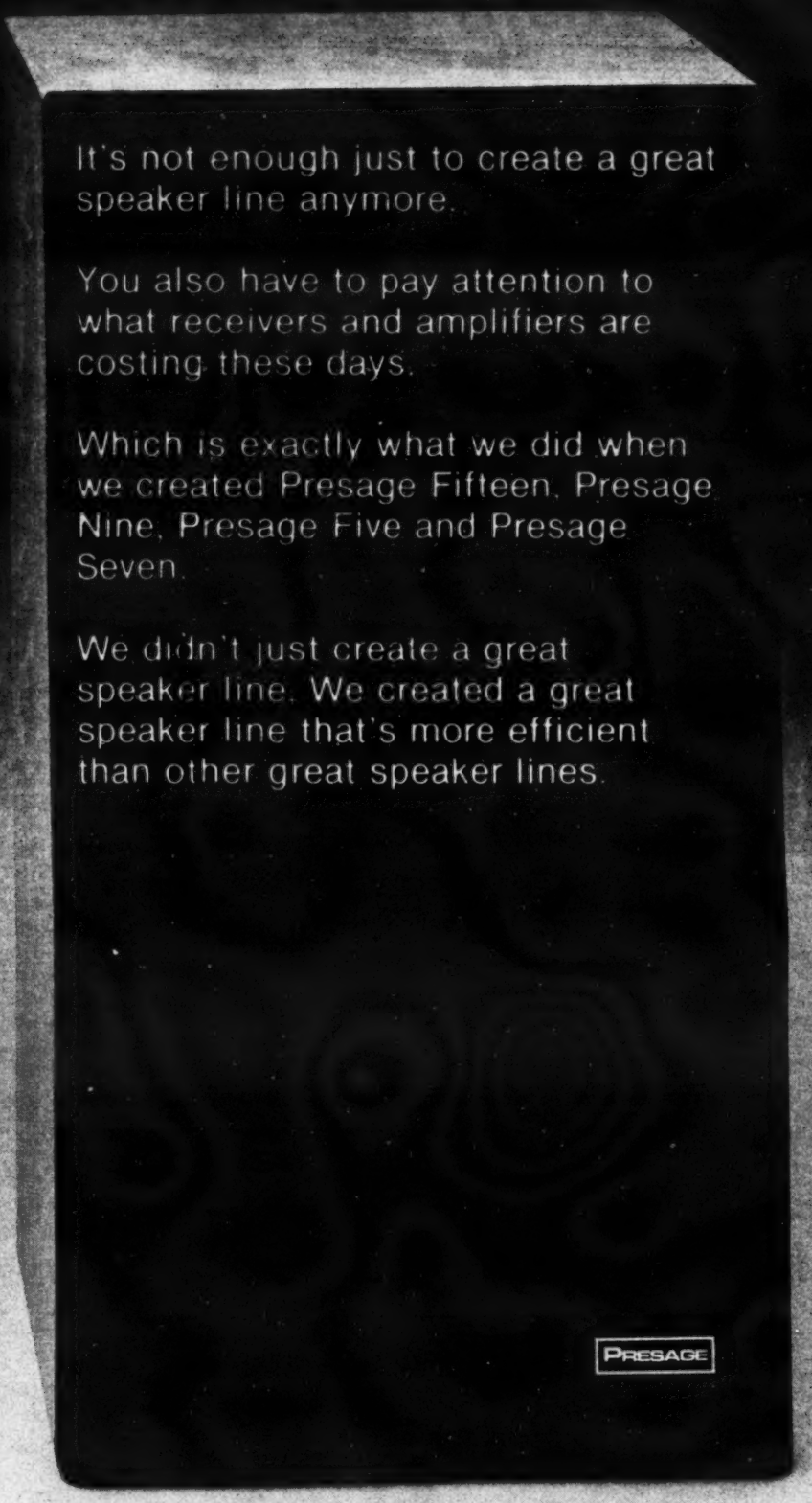
AMPLIFIERS	
Sherwood S9400	169.95
Sony TA 3130	169.95
Sony TA 1066	124.95
Sony TA 1150	199.95
Sony TA 1055	149.95
Dynaco Stereo 80kit	99.95
Dynaco Stereo 120 kit	136.95
Dynaco Stereo 150 kit	179.95
Dynaco Stereo 400 kit	349.95
Dynaco Stereo 80 A	139.95
Dynaco Stereo 120A	179.95
Dynaco Stereo 150 A	239.95
Dynaco Stereo 400 A	449.95
Dynaco Stereo 400 M/A	549.95
Dynaco Stereo SCA80Q kit	132.95
Dynaco Stereo 410 kit	309.95
Dynaco Stereo 410 A	399.95
Eico 3070 kit	69.95

PREAMPS	
Dynaco PAT 4 kit	88.95
Dynaco PAT 5 kit	154.95
PAT 5 Ass	219.95
Sony TA 2000F	379.95
TUNERS	
Nikko FAM 1200	149.95
Rotel RT 620	109.95
Hitachi FT 600	149.95
Dynaco FM 5 kit	132.95
Dynaco FM 5A	199.95
Dynaco AF 6 kit	168.95
Dynaco AF6 A	249.95
Pioneer TX9500	299.95
Sony 5150	209.95
Sony 5130	269.95
Eico Kit 3200	69.95

SPEAKERS	
Rectilinear XII	99.95
Bozak Sonora	69.95
Jensen TF 3C	79.95
Superscope 28	79.95
AR 7's	54.95
Dynaco A-25	62.50
Dynaco A-25 XL	74.95
Dynaco A-35	82.50
Dynaco A-40XL	99.95
AR-3 A	214.95
Fairfax 300	109.95
Fairfax 400	199.95
Fairfax 2A	74.95
Fairfax 350	159.95
Marantz 5	59.95

35mm SLR's		
Nikkormat FT2 (w/F2 lens)	411.50	234.95
Nikkormat EL (w/F2 lens)	584.95	344.95
Olympus OM1MD	399.95	247.95
Pentax KM (w/F1.8 lens)	378	219.95
Minolta SRT200	205	174.95
Minolta SRT 201	385	219.95
Canon TX	307	154.95
Canon FTbn	406	209.95
Pentax K2	598	349
Yashica TL Electro	280	149.95
Miranda dx-3	429.95	289.95
Minolta XE5 (w/F1.7 lens)	529	289.95

A word to the wise is efficient.



It's not enough just to create a great speaker line anymore.

You also have to pay attention to what receivers and amplifiers are costing these days.

Which is exactly what we did when we created Presage Fifteen, Presage Nine, Presage Five and Presage Seven.

We didn't just create a great speaker line. We created a great speaker line that's more efficient than other great speaker lines.

Presage Corporation. Dumaine Ave., Nashua, New Hampshire 03060. (603) 883-7828.

K+L SOUND SERVICE

75 N. Beacon Street, Watertown • Tel. 787-4073

TESTING

Continued from page 6

as loud, as a "perfect" speaker would be at that frequency. In more familiar terms the aberration would be about nine or 10 dB. Then,

4) The accuracy score is calculated. To do so the computer ignores all data below 110 Hz and above 16 kHz. It averages the magnitude of all the loudness deviation values for the remaining one-third-octave bands (between 110 Hz and 16 kHz), subtracts the average value from 1.0, and multiplies by 100. For example, if a tested speaker's deviation from flat power output averaged one dB per third-octave band, the average loudness difference quotient would be about .08 sone. Subtraction of one gives .08. Subtracting this from 1.00 gives 0.92, and multiplying by 100 yields an accuracy score of 92 percent.

On the surface, this ingenious test system seems nearly perfect. It isn't — for a number of reasons. First, it isn't sensitive enough. It could give the same accuracy score to a speaker system with a ruler-straight power curve tilted down at high frequencies (whose balance could be easily corrected, if need be, with tone controls) as to another speaker having flat power output through most of the tested range, but with a violent dip in one frequency region and a severe peak in another. There is really no doubt as to which is the preferable speaker system, but in CU's computer's eyes they are equal.

Another very serious problem occurs at the bass end. Loudspeaker systems do not behave the same in anechoic chambers as they do in rooms. When a speaker is put next to hard room boundaries, the reflections modify the speaker's power output — increasing it substantially at some frequencies, decreasing it at others.

CU justifies its accuracy scoring system by correlating the results with simulated live-*vs.*-recorded listening tests. The correlation is high, they say, if two conditions are met. First, the computer analysis must be limited to the range above 110 Hz, and the live-*vs.*-recorded evaluations must be limited to the same frequency range. Second, in the listening test, the speakers must all be at least 3.5 to four feet from the nearest room boundary!

CU says that their accuracy analysis does not extend lower in frequency because they cannot predict how your room will affect the deep bass. It is no coincidence that three and one half feet from the nearest room surface is just far enough to keep the boundary effect below 110 Hz. But in how many living rooms have you seen a pair of speakers that far away from any room surface? The fact is that people must put speaker cabinets close to a wall. A more reasonable distance for real people is one foot from woofer to wall. If CU used *that* distance for their listening tests, their correlation with the anechoic accuracy scores could not extend below 400 Hz. And 40 percent of the audible frequency range lies below 400 Hz.

Put another way, CU's accuracy scores are invalid below 400 Hz, for realistic listening conditions, and they are relatively insensitive above that frequency.

To make up for the lack of information on bass performance, CU specifies the frequency at which the bass output has dropped by half. This is useful and important information; it is a vital index of performance capability. Incredibly, CU deemphasizes it and does not include it in the accuracy score calculation.

Other tests made by CU on loudspeakers include relative efficiency (translated to amplifier power requirement) and impedance. Both give a prospective buyer useful information.

High Fidelity Magazine also relies heavily on measurements made in an anechoic chamber. These tests are performed for the magazine by CBS Laboratories. Response curves are published in the report, so that you can draw your own conclusions about them.

Three curves are given, all based on one-third-octave band levels: a curve taken directly in front of the speaker at one microphone position (the on-axis curve), an average of the output into the forward hemisphere and a total-power response curve. All the curves are shown over the full frequency range, although below 400 Hz they are no more valid than CU's anechoic tests, and for the same reasons. Above 400 Hz CBS Labs' curves are less reliable by far than CU's, because they are taken at 45-degree intervals of rotation as compared with CU's 10-degree increments.

High Fidelity also shows CBS Labs' distortion *vs.* output level figures for two test frequencies, 80 and 300 Hz. Why these frequencies were chosen is not clear, but the method of presentation is good. Of course these tests also are done in the anechoic environment, limiting their relevance in actual-use conditions. Speaker output level is also indicated, but in an arbitrary way that makes it difficult to relate to measurements made by others; the editorial comment accompanying *High Fidelity's* speaker test reports has shown the least technical sophistication of all the Big Four.

Stereo Review's speaker reports are written by Julian Hirsch and based on tests he makes with primitive equipment in his basement. These handicaps are sufficient to prevent him from producing reliable data; as a result, he has made occasional embarrassing mistakes in evaluation.

Hirsch has an excellent engineering background, however, and he is slowly getting better test equipment and refining his measurement techniques. With further work his speaker test reports could become very good, because he believes that a speaker should be tested in its working environment — a listening room.

At present, Hirsch uses a calibrated speaker system (one whose power response at middle and upper frequencies is known) to establish known reference curves for his microphone at two positions in the reverberant field of his basement listening room. Then he plays the speaker under test and records the response at the same two positions in the room. He uses the average of the two curves to calculate the power output relative to his reference system, and thereby obtains the tested speaker's power response. He considers this curve to be valid from several hundred Hz upward; with better control than he exercises (more consistent placement of the speakers and his microphone, for example), it would indeed be valid.

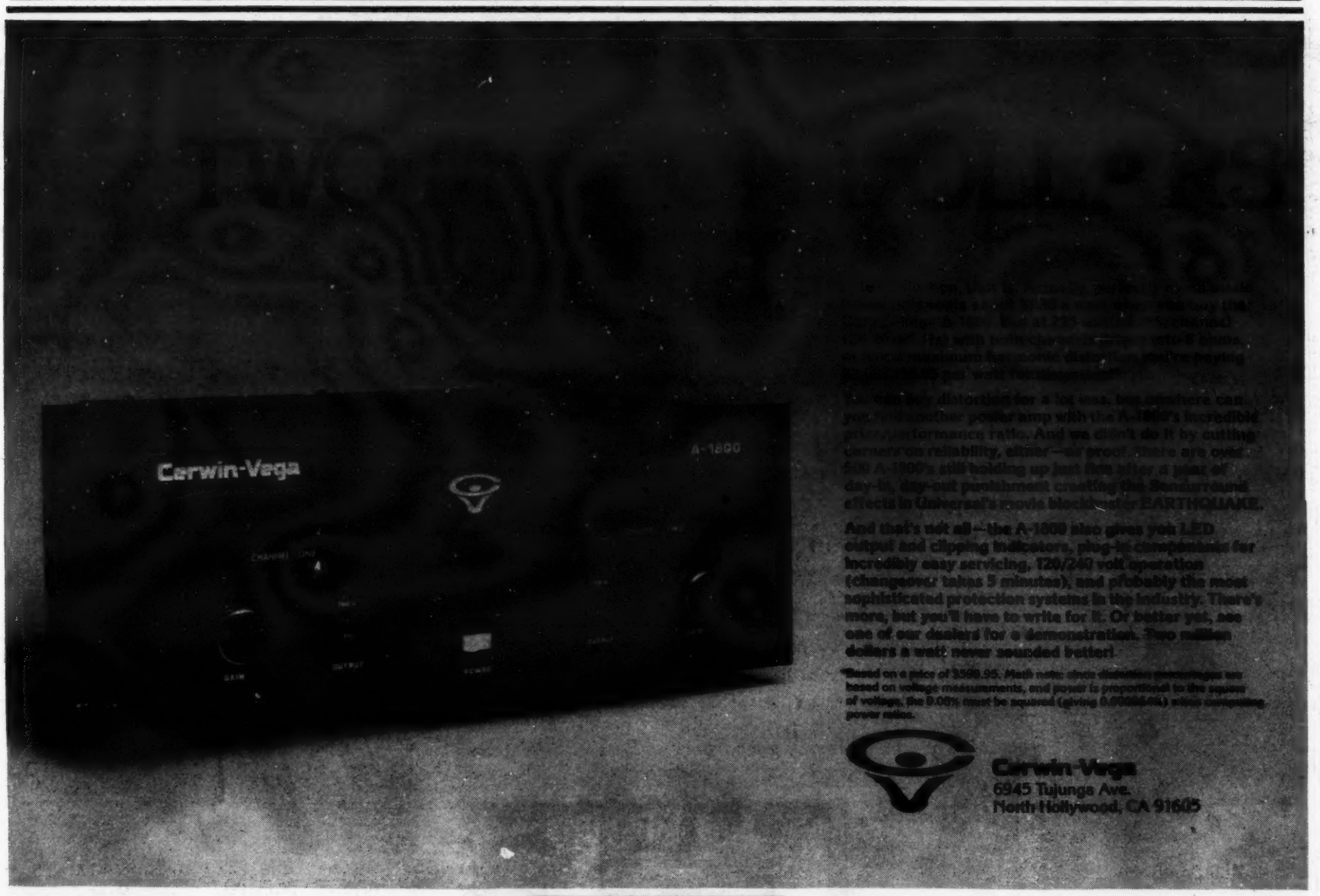
For low-frequency response he simply puts the microphone in the near field of the woofer and runs a response curve. Then he artfully patches this and his reverberant field curve together (usually there is a frequency region where they overlap). That is the response curve he describes, but does not show, in the text of his report. The low-frequency section of the curve, unfortunately, is equivalent to that which would be obtained in an anechoic chamber, so in practice even Mr. Hirsch has not yet taken the next step, that of evaluating the speaker's bass output as it is affected by a room. When he does, he will produce speaker reports that will have real value.

Hirsch also does a simulated live-*vs.*-recorded listening test as a sort of afterthought. He, too, eliminates the low frequencies, cutting off the "live" sound and its recording at 200 Hz.

Among the other speaker performance tests Hirsch does for *Stereo Review* are low-frequency distortion *vs.* input power (only moderately useful), output level on axis (with standard measurement conditions, so that it is comparable with measurements made by others under the same conditions), and tone burst performance (unfortunately made with second-rate equipment).

So much for the Big Four. I doubt if my descriptions inspire much confidence in what you read. But what are the alternatives? There are a number of small-circulation equipment review publications, such as *Stereophile*, *The Absolute Sound*, and *StereOpus*, which specialize in the "golden ear" approach: no instrument tests, or very few; strictly subjective evaluations, characterized by descriptive phrases like "subtly grainy" or "gray velvet" sound. A review in one of them spoke of a component's unique ability to "float the percussion section of an orchestra slightly up and over the rest of the orchestral sound." The component in question wasn't even a speaker; it was an *amplifier*. You see what I mean.

The only sure way to learn if a speaker is for you or not is, still, to listen to it yourself in as many environments as possible — best of all, in your own living room — comparing it with your memory of how live music sounds.



Carwin-Vega
6945 Tujunga Ave.
North Hollywood, CA 91605

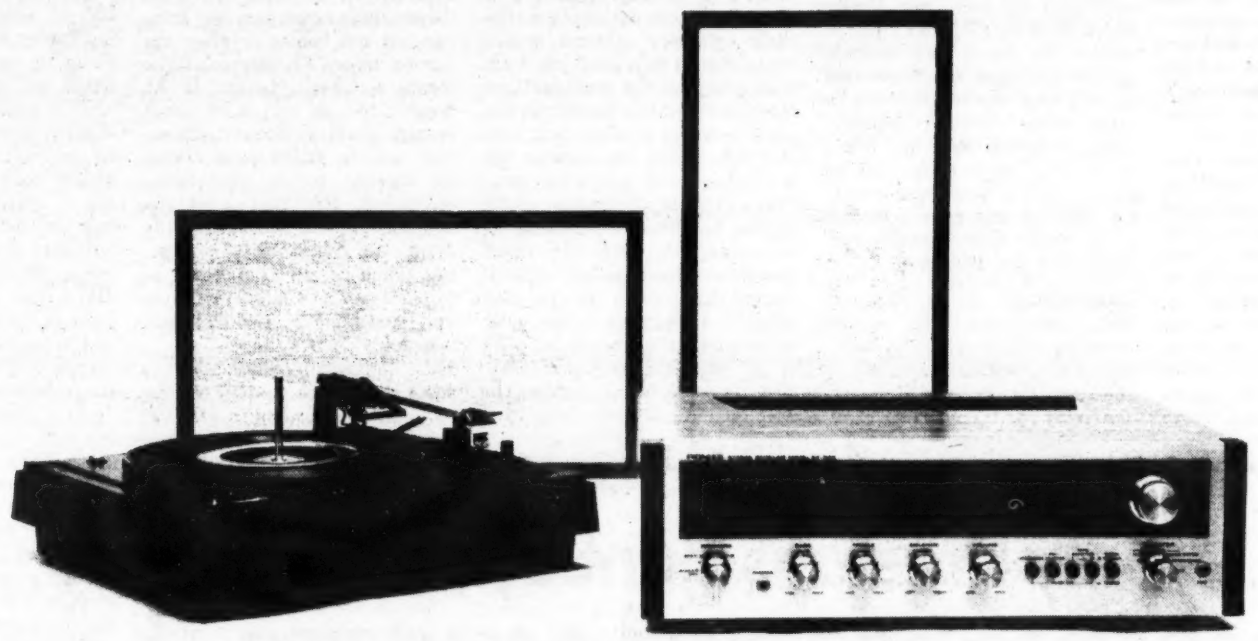
Available At:

K+L SOUND SERVICE

75 N. Beacon Street
Watertown • 787-4073

We are not your stereotyped stereo store!

Because of the new Advent/3 speaker, this will unquestionably be the best $300 system you've ever listened to.



Most low-cost stereo systems give you "low-cost" sound. Usually because of the speakers.

But this low-cost stereo system is different because of the Advent/3 speakers it includes. These amazing new speakers deliver accurate, convincing, truly wide-range sound. (See Advent ad).

Plus this system also includes both a fine quality receiver and turntable. The receiver is the Rotel RX-202, with enough power to drive the Advent/3's with concert hall realism. And the Rotel tuner will pick up even hard-to-get small college stations.

As for the turntable, it's the BSR2260 with base, dust, cover, cueing and a SHURE Cartridge.

Feast your ears at the Tweeter nearest you.

Tweeter etc.

Our new store. 874 Commonwealth Ave., Brookline, (Across from B.U.) 738-4411.
Harvard Sq. 102 Mt. Auburn St. 492-4411.
Chestnut Hill Mall. 964-4411.
Brockton. 849 Belmont St. (Rt. 123 just off Rt. 24) 583-5146.

HIRSCH

Continued from page 4

the product. We don't go in heavily for curves or scope photographs, for space reasons; the curves that you see in a typical report in *Stereo Review* are maybe one-fifth to one-tenth of what I supply to them, and they simply can't print them; there isn't room.

My own personal philosophy is very heavily consumer-oriented, rather than hobbyist-oriented, if I may make that distinction. In other words, it is important to me that a product operate the way it is apparently supposed to operate: when you turn a knob, it should turn positively to the position you intended it to go to, and it should stay there and not fall off. There shouldn't be loud clicks from switches that aren't supposed to make loud clicks. The dial of a tuner, if it's set to 96.3 MHz, should indicate that the tuner is tuned to 96.3 MHz, not 96.1 or .5. If the product is very easily damaged in only slightly abnormal usage I consider that a major drawback, no matter how great-sounding it is. If it's a loudspeaker, and it's the world's greatest, and it has to sit in a certain position, and it costs a thousand dollars each, and it looks like something from another planet, I would be very cool toward it, simply because I'm not looking for the "state of the art," *per se*, but for something which will be of interest to people who are just interested in hearing good sound.

BP: Do you assume that the people who are reading the reviews are primarily oriented toward classical music or popular music, or do you make no such assumption at all?

JH: To the greatest extent possible I don't make any assumptions about what they're listening to. I can't help having my own taste color my reaction to products, but that's only in regard to such things as loudspeakers, which have a sound of their own. There are certain speakers which are supposedly only good for rock, and others which are good for other kinds of music. I'm not a rock enthusiast, so a speaker which excelled in rock and was second-rate in other respects would probably rank pretty low with me. But I try to lean over backwards to avoid labeling a product simply because of my own personal tastes, unless it's something very positive or very negative.

Lemon Aid

BP: There have been — and probably will continue to be — occasional products arriving in the marketplace which are genuinely bad, but which receive such an enormous marketing effort and are peddled through dealers with such high profit potentials that they will be sold to consumers who won't learn until it's too late that they are a bad value. Maybe it should be the audio-consumer magazine's duty to warn against products which are being misrepresented?

JH: Well, I think the instances that you refer to are exceedingly rare these days; they were not so rare 10 or 20 years ago, and there were plenty of out-and-out ripoffs that appeared in the earlier days of component high-fidelity. Most companies in this field are planning to stay in business for a while, they would like to be profitable, and they are not going to be profitable if they turn out an inferior or misrepresented product. So on the assumption that their own self-interest would lead them to do a good job, I am willing to give the manufacturer the benefit of the doubt. In the cases where a product has serious defects, we get back to the manufacturer and we say, "Look, this thing is not a credit to you, you would be unhappy if we printed the report. Why don't you fix it up and make it what it should have been in the first place?" In almost every case, subsequently he comes out with it in revised form, and everybody is much happier about the results. I think we're benefiting the manufacturer, and we're benefiting the readers, because by the time a review comes out in print, it's on an accurately represented product.

BP: Popular suspicion has been that when you write a review, the publisher may suppress it to retain an advertising contract. Has there ever been a case in which a review of yours was suppressed from publication?

JH: Not that I know of. There have been a number of cases where heavy advertising contracts have been lost *subsequent* to the publication of our reviews, not necessarily because we damned a product but simply because we didn't yell that this is the world's greatest whatchamacallit. There are some manufacturers who are very thinskinned on this. My publishers have never put any pressure on me before or after the fact to change a report to suit the manufacturer's taste. If he doesn't like it, and if he raises enough of a stink about it, the report may be killed for diplomatic reasons before ever being published. But that's not the same as allowing him to alter the content of the report. Any editing which occurs on a report of mine is solely a matter of style and space, never the technical wording.

BP: The writing style and, to some extent, the content of your reviews as published in *Popular Electronics* are strikingly different from what appears in *Stereo Review*. Do you write two versions of the report, or do you write one report and then have it re-written by someone for *Stereo Review*?

JH: What I write for *Stereo Review* is almost in its final form. They do very little editing. Sometimes what I do for *Popular Electronics* is essentially a paraphrasing. I get into things a bit more technical in *Popular Electronics*, on the assumption that the readers might understand it better, but the editors do considerably more re-write on that end, and therefore the style of those articles tends to reflect some of their input as well as mine.

Vital Statistics

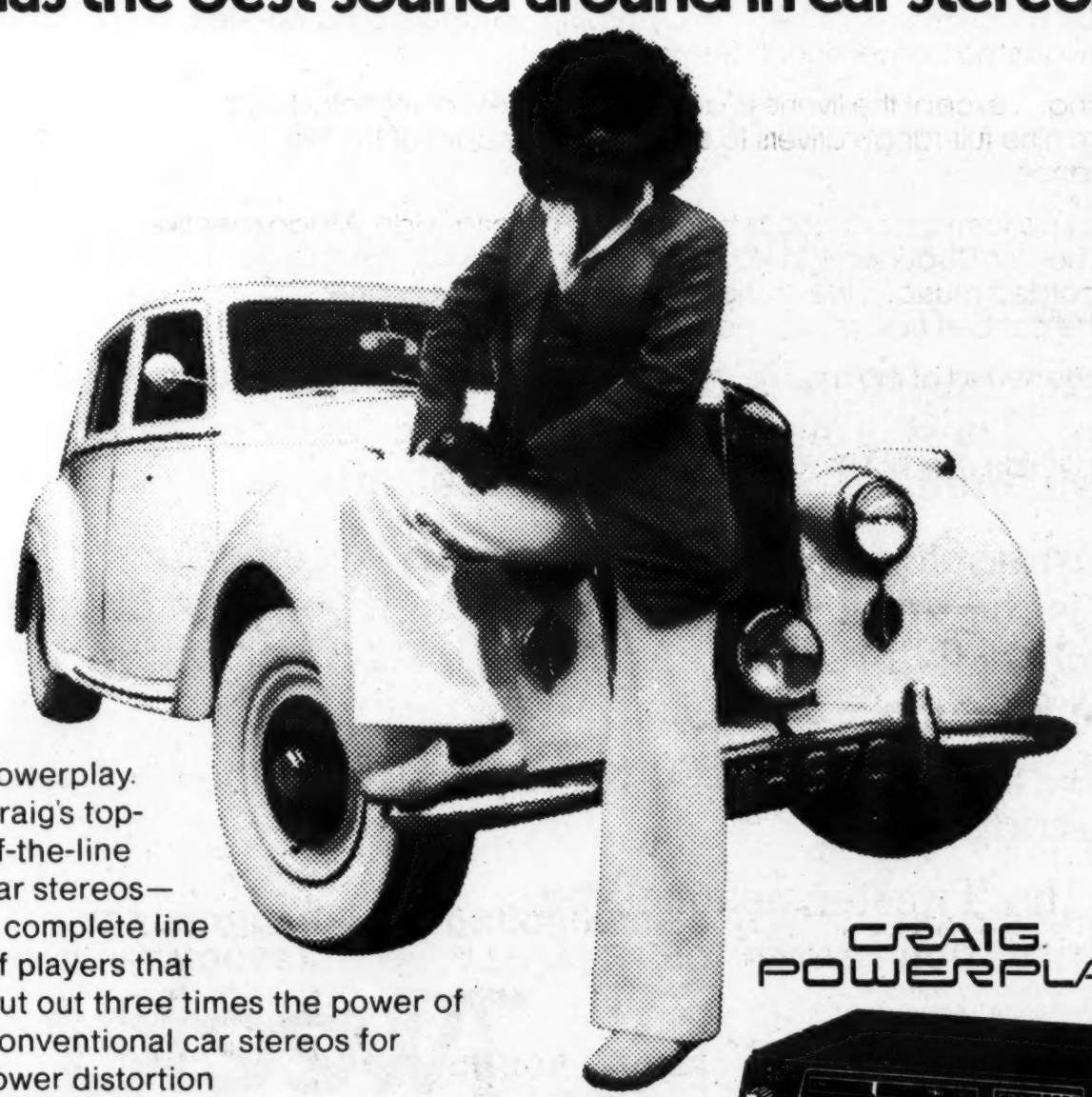
BP: In some of the magazines the reader is fed almost a catalogue of technical data with either no interpretation as to what it means, or only a rather skimpy interpretation, or even an incorrect one. Are there some widely used technical measurements which you feel don't relate very well to the actual performance of the unit and so are not worth recording?

JH: I feel that many, if not most, of the measurements that I and most others make do not convey very much information to the consumer about how the products perform. They don't convey that information to me, so I don't know why they would to someone less informed on the subject. Nevertheless, there is a feeling — and I'm not speaking about the publications I write for, it's general among all of our readers — they want to see these technical matters presented in a form which makes them feel that they're meaningful. Now, as for going into specifications, this is a compromise which I'm never happy with. I wish I could say as a preamble to every report, "To find out what this does, get the manufacturer's literature, read what he says about what this is, and then go from what I find it to be." I obviously can't do that.

The other extreme would be to do as some do, to print a specsheet for the thing. This is space-consuming, although I suspect it might be less space-consuming than what I end up doing, which is to pick a few of the key points. From there, I go into a general description of what control features it has — and there I'm never sure if I've gone too far or not far enough. I could explain what every knob does, which is basically what I do, with certain feelings of unhappiness. The "laboratory measurements" section of the report then gets into the measurements I make, and they could be presented in simple tabular form — a few tables, a few graphs, which would leave very little if any text. For editorial reasons, the magazine wants to do it the way they do it, which is perfectly all right also. But it's in the final section that I state "what I really think." At least there I'm free to give my gut reaction, which, to me, is the distillation of everything that's come before. With an engineering background, I appreciate good engineering design, which is a rarity, and therefore I'll sometimes comment on it, and maybe some readers will be completely turned off. They won't understand why a serviceable product is especially interesting to me, why something that hinges open and has easily removable circuit boards and accessible connections — why I should make any point of that. I can't help it. That's a product of my upbringing. I am a nut on tactile sensations. This is more important to me than whether an amplifier has 0.002 or 0.02 or even 0.2 percent distortion, because I can't hear that distortion. But I can feel that knob. And it doesn't cost any more, I don't think, to do it right than to

Continued on page 12

Billy Preston's Bentley
has the best sound around in car stereo.

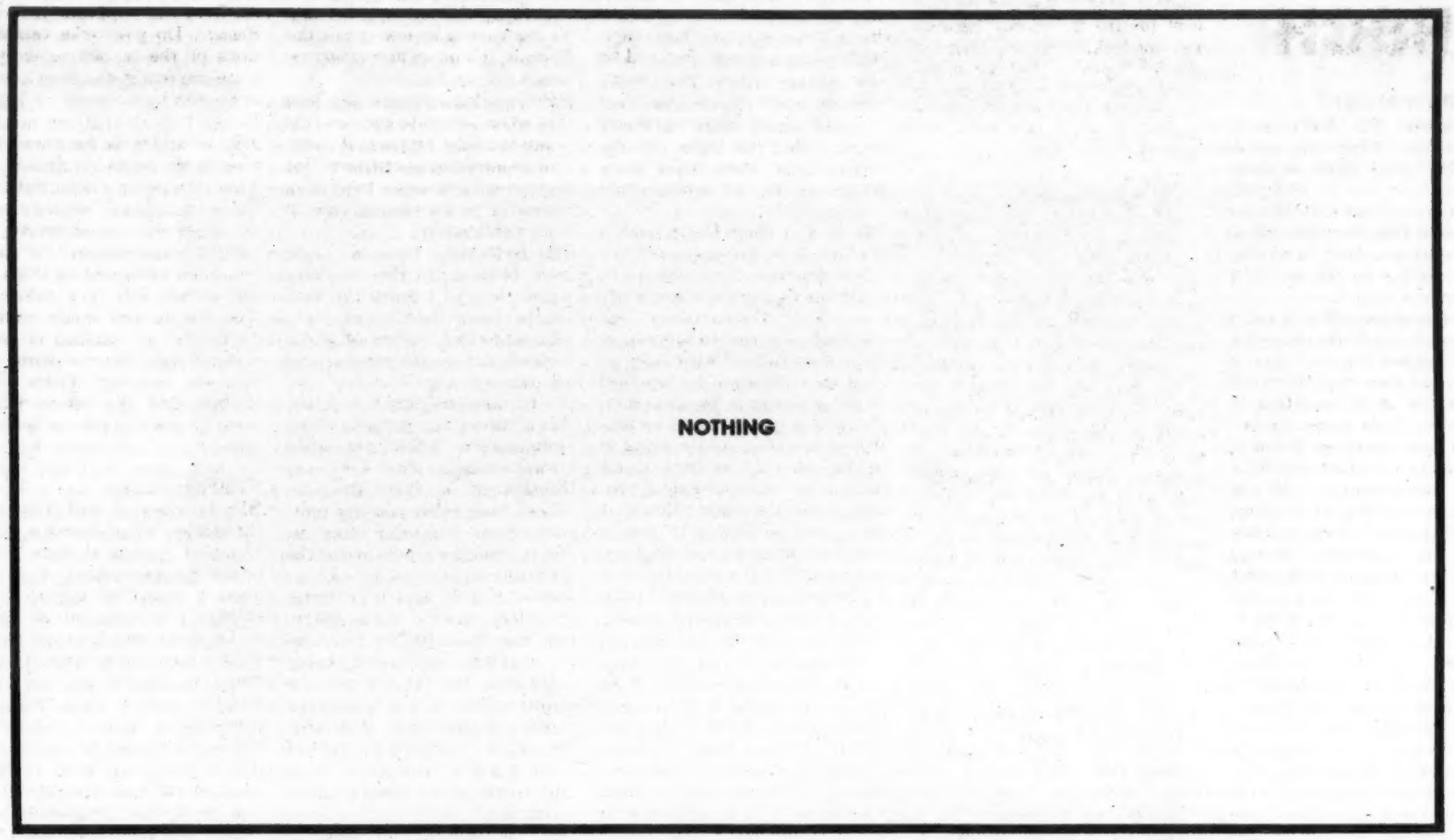


Powerplay.
Craig's top-of-the-line car stereos—
a complete line of players that put out three times the power of conventional car stereos for lower distortion and better sound at any volume.

CRAIG POWERPLAY

For the best in car stereo, see your local Craig dealer

CRAIG.



That's the answer.

The question? What does the Bose 901® Direct/Reflecting® speaker system give you... besides the most realistic sound obtainable?

It gives you no unnatural beaming of sound, no coloration, no fancy extra features that serve no purpose. It does this by having no woofers, no tweeters, no crossover networks, no conventional design.

It gives you nothing... except the liveness and spaciousness of reflected and direct sound from nine full-range drivers to simulate the impact of the live musical performance.

Nothing... except performance that has been praised world-wide. Magazines like Belgium's La Revue des Disques de la Haute-Fidelite have said: "It is grand! It is no longer recorded music... the orchestra is there in front; and the atmosphere of the concert hall, all around!"

Nothing except the sound of the most highly reviewed speaker... regardless of size or price.

The 901. There's nothing else like it.

BOSE

Better Sound through Research.

Patents issued and pending. For a full color brochure on the 901, write: Bose, The Mountain, Framingham, MA. 01701
For a reprint of Dr. Bose's Technology Review articles on the research behind Direct/Reflecting loudspeakers, please enclose $.50.

Available At:

ATLANTIS SOUND
10 Sylvan Street
Peabody, MA

38 Brattle Street
Cambridge, MA

811 Boylston Street
Boston, MA

328 Main Street
Worcester, MA

1092 Commonwealth Avenue
Boston, MA

BRANDS MART DISTRIBUTION CENTER
(Admittance only with Brands Mart Courtesy Card or Student I.D.)

127 Smith Place
Cambridge, MA

NANTUCKET SOUND
North Dartmouth Mall
North Dartmouth, MA

Cape Cod Mall
Hyannis, MA

Swansea Mall
Swansea, MA

SEIDEN SOUND OF PITTSFIELD
42 Summer Street
Pittsfield, MA

SEIDEN SOUND
15 East Pleasant Street
Dover, NH

RADIO SHACK ASSOCIATES STORES
Drum Hill Plaza
Chelmsford, MA

Lafayette Plaza
Portsmouth, NH

Newington Mall
Portsmouth, NH

Seabrook Southgate
Seabrook, NH

Tri-City Plaza
Dover, NH

HIRSCH

Continued from page 10

do it wrong. But I feel it's worthy of comment when someone does it right. And when he does it wrong.

I think a tuner dial should tell you what frequency your tuner is set for. It shouldn't be a cosmetic attraction on the panel. The majority of them have enough error to be appreciable. This kind of thing I feel is important, and you'll appreciate that this puts me poles apart from the "far-out fringe" of audio enthusiasts. I won't put any more labels on them, but these are the people who claim to hear some of the most extraordinary subtle differences (and maybe not so subtle) between products whose tests are essentially identical. My own experience has been that usually there's something else they're hearing. I have to take this approach (in self-defense, perhaps), because I don't hear these differences. And I have a set-up comparable to what a modest-sized hi-fi dealership would have. Everything's connected through a switching panel, I can connect any source through any amplifier through any speaker just by pushing a button. So I can make comparisons instantly, and I do, and in general I don't find these differences, which is why I'm a complete skeptic on the whole subject. I nevertheless preserve an open mind. I'm willing to concede that there may be these differences — I just want somebody to show me.

Balancing Acts

BP: I've gotten the impression, reading your reviews over the years, that your preference in octave-to-octave tonal balance in speakers has evolved. When you reviewed the AR-4x back in 1966, you stated that with the tweeter level control turned all the way up, the speaker measured within plus or minus three dB all the way up to 15,000 cycles — an extraordinary accomplishment for such an inexpensive loudspeaker. However, you went on to say it actually sounds most natural on music with the tweeter control turned down about half-way, turning down the highs six or eight dB. But in the last three or four years you have tended to praise those loudspeakers whose power output is rather close to flat over the whole frequency spectrum. Is that just a natural evolution due to records' being made differently than they were 15 years ago, so that they sound more attractive on a brighter speaker than was the case 15 years ago?

JH: I think my tastes have not changed as much as you've surmised. In the case, for example, of a speaker like the AR-4x and others roughly similar, the reason there was one of balance. It's a speaker that did not have a heavy bass by any means, so it would sound more balanced if you rolled the highs off. Since that time, there have been a number of small speakers which have a full frequency response — really full, even though the box is small. If it can produce 35 or 40 Hz, then there's no reason why it shouldn't go all the way out of the top end. The uniform energy spectrum in the listening room is the most desirable criterion for a speaker. In simply listening to the comparison between a live source and its reproduced sound in my own listening rooms, I've been struck by the fact that the speakers which sound most natural, most like the original sound, are almost always the ones with the flattest wide-band response.

The measurements that I make of speakers are quite different from those made by others. For one thing, I can't make the measurements that a giant company with an umpteen-thousand-dollar anechoic chamber can make — I don't have that facility. Secondly, it's a matter of philosophy. I don't believe that an anechoic chamber is the proper environment for evaluating the sound of a loudspeaker. It's a great thing for evaluating the design of its drivers and its crossovers, but it tells you nothing whatsoever (not me anyway) about the sound.

When I see a curve — or even a family of curves — taken anechoically, I have to do a bit of interpretation on them to get a rough idea of what I think that speaker would sound like, but it's an awfully crude way of doing it. What I do is measure in a real room, in the reverberant field — and I know I'm in the reverberant field because I can walk around the room and get constant sound pressure level within two db.

If you have a speaker which is calibrated in a reverberant chamber, or in which you have a total energy output calibration, (and I have such speakers which have been calibrated for me), if you play it in that room and make measurements back where I measure, you get a certain response curve, which is far from flat because the room and the microphone affect it. But then when I take another speaker and put it in the same place as the calibrated speaker and repeat that measurement, I get a different response curve. And the difference between those, corrected for the known calibration curve of my original speaker, is a remarkably close presentation of the total acoustic output of the speaker. When I say remarkably close, I mean that I can come usually within two or three dB of curves done in very elaborate and controlled situations, all the way up to 20,000 Hz.

So I think that my measurement, which is done under admittedly crude conditions, and which correlates beautifully with how a speaker reproduces an original live sound source, is a valid measurement. Of course, you can't measure lows this way; lows usually are measured separately and much more accurately by sticking a microphone right into the plane of the woofer opening. There you've eliminated the effects of the room, and you have a beautiful, honest-to-goodness bass response curve. And then the real variable is splicing these two curves together, and at this point I'm very thankful that *Stereo Review* usually doesn't publish my speaker curves, because I don't have to justify them. There's an element of art involved in splicing them, and my own judgment of what it sounds like, because I have my choice when making those curves of making a speaker curve look bassy or top-shy or whatever. So, depending on how it really sounds is how I splice it. The point is that my measurements do correspond with what I hear, and this does correlate with the reproduction of an original sound source.

BP: The traditional argument made in favor of sloping down the output of a speaker with increasing frequency is that, at least in terms of classical music, when recordings are made the microphones are 20 feet away from the musicians, and when you sit in a concert hall you are 60 feet back in the reverberant field, where the hall acoustics have altered the tonal balance of the sound you are hearing. Oughtn't the loudspeaker at least have available that kind of tailoring of the sound, by way of a switch, to mimic what you hear in a concert hall, since the sound of a concert hall isn't available anywhere else in one's hi-fi system?

JH: No, nor is it available anywhere else once the record is made, either. I understand your point perfectly well, but it's just a question of philosophy for the speaker designer. I think one way or another, the listener should have the option of tailoring his response; whether he does it at the speaker or electronically doesn't matter. My own feeling is that the speaker should be as flat as is reasonable to make it, on the possibly futile assumption that someday, things will get better. The one thing I've discovered is that you really cannot equalize a speaker to make it any better than it is to start with. I can't anyway. You can lift up lows or highs a little bit, but if equalization is done by boosting, to overcome a deficiency, you have to apply more than a very small amount of it, and you are starting to run out of watts very fast, in your amplifier and in your speaker's ability to handle those watts. A lot of people forget that 30 dB is a thousand-time power change.

I find, in equalizing the peaks out of a speaker by reducing, that that's a very unsatisfactory solution, because my own offhand guess is that many of those peaks represent some kind of a resonant condition, whether in the speaker or in the room or in a combination of the two. And you can't equalize out a resonance. You can reduce the sound pressure at the measurement point to what you want it to be, but a resonance will ring, and you're not going to equalize that out of it.

My greatest problem these days is finding something real nasty to say about a speaker, because most of them are just too darned good. This will, again, of-

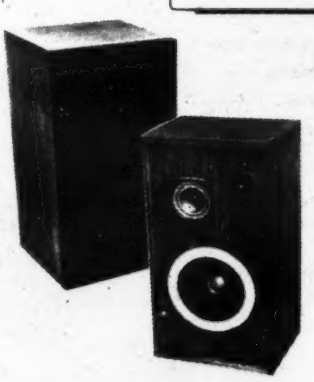
Continued on page 28

KLH Dedicated Loudspeakers. A New Standard in Sound and Styling.

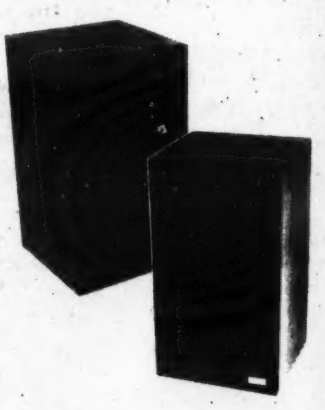
KLH has always had the uncanny ability to make graceful loudspeakers that could reproduce a remarkable amount of sound. This, coupled with an unfailing reputation for quality and hand craftmanship, is the benchmark of the KLH tradition. With the Dedicated Series of KLH loudspeakers, the company adds further to that tradition by setting a new standard in sound and styling. Each of these five superb loudspeakers borrows freely from KLH's classic technology and engineering. All use our amazing woofers. And all (except the Model 331) are of acoustic suspension design. The tweeters, midranges and cross-over networks are all vastly improved devices of completely new manufacture that represent the industry's most advanced technology. Each of the Dedicated Loudspeakers boasts increased efficiency over previous models — with much brighter sound and greater overall musicality. And each of them, regardless of size or price, recreates the subtleties and innervoices of the orchestra demonstrably better than past competitive models. Stated simply, they are easily among the best loudspeakers we, or anybody else, has ever made. They are also unquestionably, the best value we have ever offered. And since we've always offered one heck of a lot of speaker for the money, that's saying quite a lot. Here then, dedicated to you, is the new KLH Dedicated Series — beautiful loudspeakers for people who really care about what they hear.

KLH

KLH MODEL 354
- 8-Ohm, three-way acoustic suspension loudspeaker system
- One very low resonance, 12-inch KLH woofer, one 4½ inch midrange, one 2¼ inch cone tweeter
- Walnut veneer on high density particle board
- Two rotary switches — one 3-position midrange control and one 3-position tweeter control
- Removable front grille panel
- Pedestal optional



KLH MODEL 363
- 8-Ohm, three-way acoustic suspension loudspeaker system
- One 12-inch KLH woofer, one 5-inch midrange, and one 2¼ inch cone tweeter
- Wood grained vinyl on high density particle board
- Two rotary switches — one 2-position midrange control and one 3-position tweeter control
- Removable front grille panel



KLH MODEL 331
- 8-Ohm, two-way ported cabinet loudspeaker system
- One long excursion 8-inch woofer and a 2¼ inch cone tweeter
- Wood grained vinyl on high density particle board
- Removable front grille panel

KLH MODEL 317
- 8-Ohm, two-way, high efficiency, acoustic suspension loudspeaker system
- One 10-inch KLH woofer and a 2¼ inch cone tweeter
- Wood grained vinyl on high density particle board
- Three-position control switch (toggle)
- Removable front grille panel

Use Your Lechmere Charge Card

LECHMERE the more store
WHERE YOU POCKET THE DIFFERENCE

CAMBRIDGE, 88 First St., 491-2000, **DANVERS,** Liberty Tree Mall, Endicott St., off RT. 128, 777-1000, **DEDHAM,** 688 Providence Hgwy., RT. 1, 329-2200, **SPRINGFIELD,** Springdale Mall, 1550 Boston Rd., opposite Eastfield Mall, 543-5100. **STORE HOURS: CAMBRIDGE,** Mon. thru Fri., 10 A.M. to 10 P.M., Sat., 9 A.M. to 6 P.M., **DANVERS, DEDHAM, SPRINGFIELD,** Mon. thru Sat., 10 A.M. to 10 P.M.

Does he really hear better?

Most home stereo systems are operated by men because they hear better.

Right?

Wrong!

Yamaha wants to dispel this myth. Women, in general, hear the upper frequency range better than men. Women also are quicker to perceive distortion in the music. But a woman knows how delicate her man's ego can be. Perceiving a high level of distortion, she says, "Please turn the music down. It's too loud."

YAMAHA HAS THE SOLUTION

We recognize that distortion can ruin your listening pleasure. Distortion is one of many tests all components are subjected to before becoming a part of our product line.

While other manufacturers are mostly concerned with more and more power, Yamaha's engineers have concentrated on less and less distortion.

Particularly intermodulation (IM) distortion, the most irritating to your ears. By virtually eliminating IM's brittle dissonance, we've given back to music what it's been missing.

A clear natural richness and brilliant tonality that numbers alone cannot describe. A new purity in sound reproduction.

At Yamaha, we make all our stereo receivers to a single standard of excellence.

A consistently low intermodulation distortion of just 0.1%!

A figure you might expect only from separate components. Maybe even from our $850 receiver, the CR-1000. But a figure you'll surely be surprised to find in our $330 receiver, the CR-400.

Between our $330 CR-400 and our $850 CR-1000, we have two other models.

The $460 CR-600 and the $580 CR-800.

Since all are built with the same high quality and the same low distortion, you're probably asking what the difference.

The difference is, with Yamaha, you only pay for the power and features that you need.

Unless you have the largest, most inefficient speakers, plus a second pair of the same playing simultaneously in the next room, you probably won't need the abundant power of our top-of-the-line receivers.

Unless you're a true audiophile, some of the features on our top-of-the-line receivers might seem a bit like gilding the lily. Selectable turnover tone controls, variable FM muting, two-position filters, even a special five-position tape monitor selector.

However, you don't have to pick one of Yamaha's most expensive receivers to get a full complement of functional features as well as our own exclusive Auto Touch tuning and ten-position variable loudness control.

The End of the Double Standard.

Just keep in mind that all Yamaha stereo receivers, from the most expensive to the least expensive, have the same high quality, the same low distortion, the same superlative tonality.

It's a demonstration of product integrity that no other manufacturer can make. And, an audio experience your local Yamaha Dealer will be delighted to introduce you to.

YAMAHA

International Corp., P.O. Box 6600, Buena Park, Calif. 90620

Audio Den
So. Burlington, Vt.

Audiocom
Old Greenwich, Conn.

Del Padre
Springfield, Mass.

Hi Fi Stereo House
Newington, Conn.

Images Sight & Sound
Fall River, Mass.

Manchester Music Audio
Manchester, N.H.

Malco Electronics
Lawrence, Mass.

M.G.F. Melody Shop
Keene, N.H.

Minuteman Radio
Cambridge

Music Store
Greenfield, Mass.

N.E. Music Co.
Portland, Maine
Bangor, Maine
Waterville, Maine

Stereo One
Fairfield, Conn.

Stereo Lab
New London, Conn.
Groton, Conn.

Soundsmith
Portsmouth, N.H.

Stereo Places
No. Providence, R.I.

Stereo Theater
Rutland, Vt.

Sound Ideas
West Hartford, Conn.

Suffolk Audio
Cambridge

Stromboli Ent.
Lewiston, Maine

David Dean Smith
New Haven, Conn.

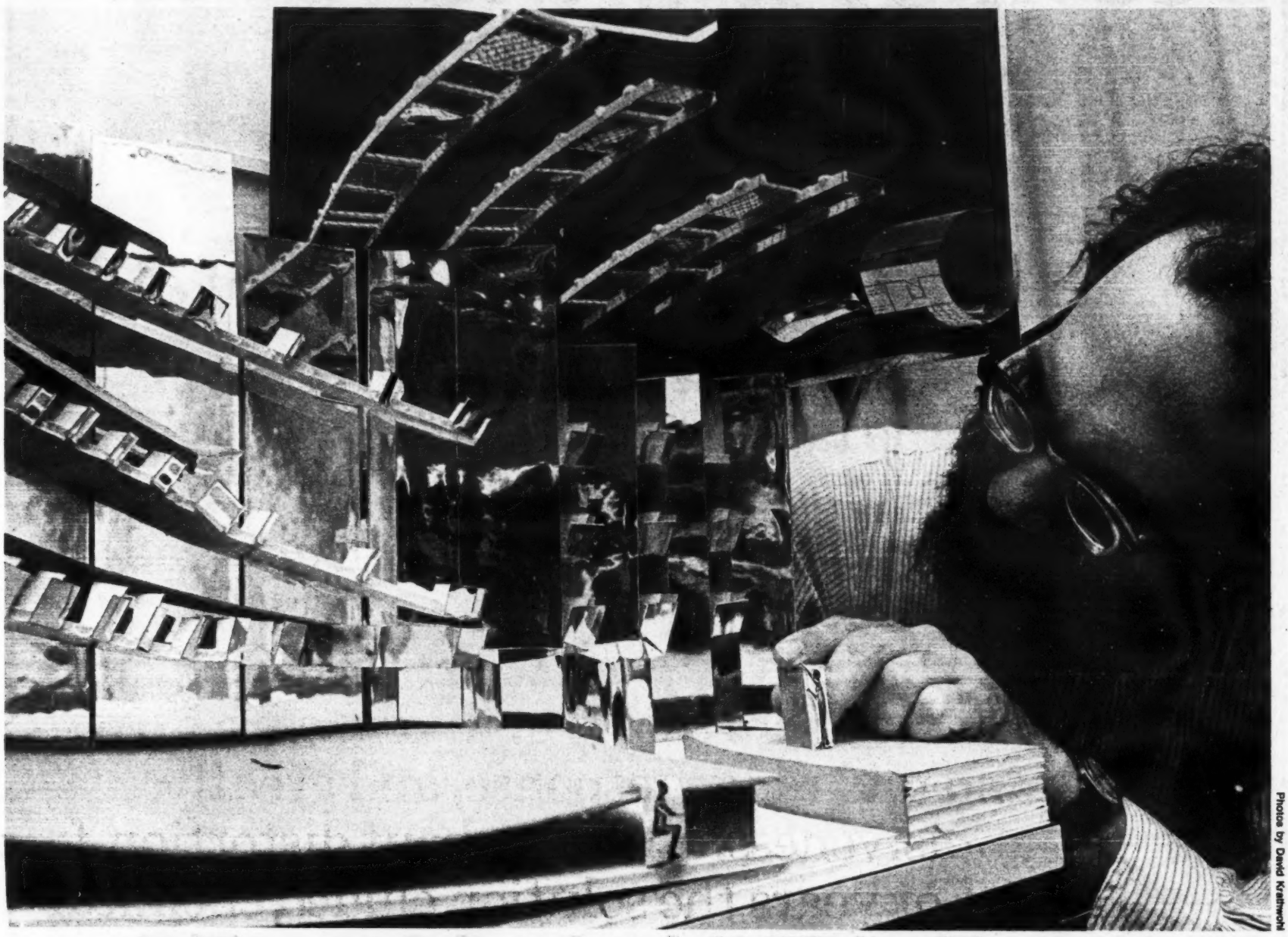
Tweeter, Etc.
Brookline
Brockton
Ha. Sq. Cambridge
Chestnut Hill

Tripod Audio
No. Hampton, Mass.

Fitchburg Music, Inc.
Fitchburg, Mass.

J. Robert Barry
Manchester, Ct.

Sounds Incredible
Danbury, Ct.



Photos by David Krathwohl

BBN HAS GOOD VIBRATIONS

Inside an acoustical think tank

by Clif Garboden

This is what science fiction should be. Remember all those movies when the man-eating fungus or the chimpanzee with a 198 IQ is freighted off to the "research center" where everybody walks around in white lab coats and fiddles with giant wall consoles of sexy gadgetry? It's not like that.

Sci-fi moviemakers automatically assume that by the time we thoroughly technologize our society, we'll have learned to eliminate old coffee-cups and unemptied ashtrays, so they turn their movie sets into cosmetic wonders. The scientific testing facilities at Bolt, Beranek and Newman's Fresh Pond headquarters don't make it a showplace. It's as if you took a million-dollar piece of sophisticated test equipment and plopped it into the basement of an apartment building on Buswell St. It's clearly not there for show, and everybody's white coat must be at the cleaners.

(Top) A staffer checks a model of the opera theater at the Victorian Arts Center, Melbourne, Australia; (above) BBN's small wind tunnel.

Except for the unexpectedly casual — even downright pedestrian — atmosphere of the place, walking down the hall of BBN's lower level *is* reminiscent of playing an extra in *The Thing That Ate Guam*. Most of the doors are open. One room lets out an occasional beep. Another room goes thunk-thunk-thunk. Inside, Cambridge types in plaid shirts sit around munching sandwiches in front of scopes, video displays and lots of lights, dials and buttons. It looks like a club house for MIT grads.

Which it is. BBN was started in 1948 as a partnership of MIT profs — the principals being Richard H. Bolt, now BBN's chairman of the board, Leo L. Beranek, now president of Boston Broadcasters, Inc., and Robert B. Newman.

In the beginning, the company's specialty was acoustical consulting, mostly for architects. Since then the business has grown. BBN oversees the operation of seven divisions, Architectural Technologies, Environmental and Noise Control Technologies, Underwater Technologies, Information Sciences, Computer Sciences, Instrument Systems and Geomarine Services. The company manages to handle all this with as few as 770 employees deployed between the Cambridge headquarters and regional offices in Washington, Chicago, Los Angeles, San Francisco, Houston and Oxnard, California. Five-hundred seventy-five of these employees are classified as scientists or engineers, and two-thirds of those hold advanced degrees.

The company's function is still primarily consulting. BBN doesn't build concert halls, they just tell people who are building them how to make them work as concert halls. BBN doesn't drill for oil, they just develop and implement test procedures to find it under the ocean floor and advise oil companies where to build their drilling towers so they don't fall over.

Half of BBN's research is done by the Computer Division, which designs and markets computer systems and technology, primarily for scientific applications. The rest of the company still deals in sound of one form or another.

Business is good. BBN's 1975 sales tallied $28,688,200. The Environmental Protection Agency (EPA) has stirred up some business in recent years for BBN, researching the environmental impact of noise-producing projects like airports and new highways.

The federal Occupational Safety and Health Act (OSHA) has broadened yet another of BBN's markets. OSHA is meant to protect people from hostile and dangerous working conditions, and to this end is establishing guidelines about everything from wiring safety and hardhat construction to the amount of noise that's allowed to happen around job sites and factories. BBN is frequently called in by one industry or another to figure out how to turn the volume down to meet Federal standards. The US Navy even hired BBN to lower the noise levels in ships' engine-rooms for fear that the Government would sue on behalf of the sailors.

Indeed, one of the company's most regular customers is the US government itself. Over the years BBN has worked for the Defense Department, NASA, Health, Education and Welfare, the State Department, the Department of Transportation and the EPA. BBN can troubleshoot virtually anything from a recording studio to a loud airplane wing, or from a teaching machine to a delinquent computer system — and the government just keeps baking more pies for BBN to put its fingers in.

During the past decade, BBN has been criticized and protested against for its military connections. BBN's 1975 accounts-receivable schedule shows that the government currently owes them over $4 million — a drop in the bucket by gov-

Continued on page 18

NOT TOO LONG AGO, CrO_2 WAS IT. TODAY, TDK SA IS IT.

TDK SA, the cassette proven to outsound chrome and the tapes that tried surpassing chrome.

Chrome was a big step forward. It provided the best S/N and superior high-end. But it had a few disadvantages.

Now TDK SA (Super Avilyn) has stepped past chrome. It offers better high-end with excellent low and mid range response, and greatly reduced abrasiveness. It's just about distortion-free.

How? For years the solution eluded chemical engineers. Until TDK developed the particle it called AVILYN.

TDK has provided the optimal density of the cobalt ion and combined it with pure gamma ferric oxide in a unique process that's different from other cobalt-treated tapes. *SA is the world's only non-chrome tape that can take full advantage of CrO_2's bias/equalization settings.* That gives you the advantage of the high-end noise reduction properties of chrome playback equalization.

TDK Electronics Corp.,
755 Eastgate Blvd.,
Garden City, N.Y. 11530.
Also available in Canada.

TDK®

Wait till you hear
what you've been missing.

THE K&L BOMBE

TO SAVE SAVE

THE LOWEST PRICES

PIONEER SX-939 Receiver $400.00

AKAI GXC-710D Front Load Cassette $295.00

LIMITED SUPPLY 24 Cerwin-Vega **Factory Seconds** Cabinet is slightly darker acoustically perfect **$200.00pr.**

(1) TEAC 3340 4 channel Reel to Reel **$875.00**

Sansui 331 Receiver $149.95

Sansui AU-2200 Intergrated amp 10/10 RMS below 0.3% Dist. **$99.95**

SUPERSCOPE C101A Portable Cassette $40.00

SUPERSCOPE CD-302A Dolby Cassette Deck **$130.00**

Garrard Zero 100C w/Audio Technica AT-13ec **$129.00**

GLENBURN 2155 A Turntables $50

PIONEER SPEC-2 Power Amp $600

ALTEC 874A Segovia $299.95 pr.

CAR STEREOS

Pioneer KP-4000 AM-FM Cassette	$136
Teac AC-5 Cassette	$100

STORE LINES

Acousti-Phase
Acoustic-Research
AIKO
AKAI
AKG
Altec
Ampex
Atlas
Audio Dynamics
Audio Technica
Audiovox
Audio International

BASF
Berkshire Audio
Beyer
BGW
BIB
BIC
Browntenna
BSR
Burwen
Buss

Cambridge Audio
Cerwin-Vega
Cetec
C/M Labs
Community Light & Sound
Concord
Craig
Clarion
Connoisseur

DBX
Denon
Dokorder
Dual
Dynaco

Editall
ESS
Electro-Voice
Empire
Epicure
Evadin

Fisher
Fons

Garrard
Gauss
Glenburn
Grace
Grado
Goldring

Hed
Herald
Hy-Gain
Hervic
Janszen
Jensen
JIL

Kenwood
KLH
Koss

Lamb
Lenco
Little

Marantz
Martex
Maxell
Meister
Meteor
Miracord
MXR

Nikko

Olympus
Onkyo

Panasonic
Phillips
Pickering
U.S. Pioneer
Pioneer of USA
PE
Pressage

Rectilinear
Revox
Rotel
Russound

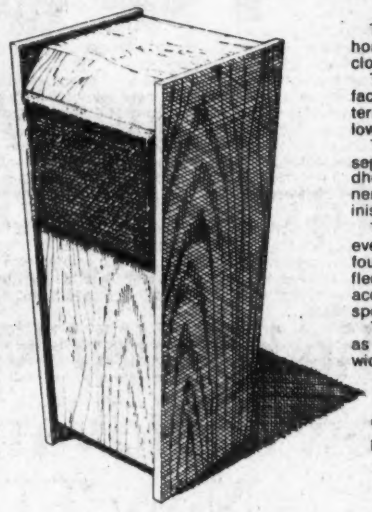
Sansui
Sankyo
Sanyo
Scotch
Scotch Classic
Scott
Sennheiser
Shakespeare
Sherwood
Shure
Shure-SR
Sonab
Sony
Sony/Superscope
Sonosphere
Soundcraftsmen
Sound Workshop
Stanton
Stax
Sumiko
Superex
Superscope
Supex
Support Systems

Tapco
TDK
Teac
Teac-Tascam
Teledyne
Thorens
Trusonic

Uher
Vac-O-Rec
Vanco

Watts
Wollensak

15 TOWER



The Cerwin-Vega 15T was developed, li
home playback equipment. Its four precisi
closure to reproduce material with unerri
The tower principle of speaker design, s
facing the floor. This permits the woofer to
teraction with the mid-range frequencies.
low as 30 cycles and capable of reprodu
The mid-range and tweeter units are ar
separation. Above 3,500 Hz., a smooth, ph
dhorm. Consisting of a highly damped 1 i
nential horn, this unique driver develops
inished even at 20 kHz.
These three drivers alone are sufficient
ever, to provide more uniform total energ
fourth driver was added to reflect frequen
flected sound may be dialed in on the sys
acoustics. The control panel also provides
sponse to be precisely tailored to a wide
The 15T is among the most efficient ho
as little as four watts of amplifier power.
wider dynamic range than virtually any o

• 15" woofer w/12 lb. magn
range • reflecting horn mid
super dhorm tweeter • freque
30-20,000 Hz plus or minus 3d
1 watt at 4 feet

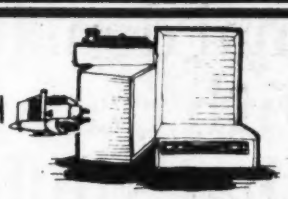
24

The Cerwin-Vega 24 is the mo
be attributed to the solid design
Cerwin-Vega engineers wanted
watt receiver into sounding more
lower, more natural bass, than e
studios, and at the same time h
The Cerwin-Vega 24 represe
characterized by their audiophile
12" woofer creating accuracy a
priced speaker. Also present is t
for the crisp transparency of tre
The value and quality is under
speaker.

• 12" woofer w/6lb. magnet
tweeter • frequency response 33
• 90 dB at 1 watt input at 4 fe

SYSTEM 485

SUPERSCOPE KLH GLENBURN SHURE

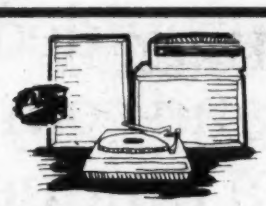


SUPERSCOPE R340B — • 15 watts RMS per channel (measured at 8 ohms, 40-20,000 Hz. below 1.0% distortion) • FM sensitivity 2.2uV
KLH 31 — • 8" woofer • 2" tweeter • frequency response 42-19,000 Hz
GLENBURN 2155A — • heavy duty induction motor • damped cue • anti skate
SHURE M75CS — • magnetic elliptical cartridge

K&L Price $229.95

SYSTEM 545

SCOTT Garrard Cerwin-Vega

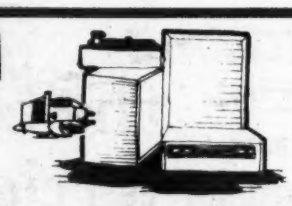


H.H. SCOTT R33AS — • 18 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz. below 0.5% distortion)
CERWIN-VEGA V-8 — • 8" woofer • dome tweeter • frequency response 40-20,000 Hz.
GARRARD 440M — • heavy duty induction motor • damped cue • magnetic cartridge

K&L Price $325.00

SYSTEM 655

SONY PE ALTEC STANTON



SONY STR-7025 — • 17 watts RMS per channel (measured at 8 ohms, 40-20,000 Hz. below 0.8% distortion.
ALTEC 3840 — • 10" woofer • 2" tweeter • frequency response 38-20,000 Hz.
PE 3044 — • fully automatic turntable • damped cue • anti skate
STANTON 500EE — • magnetic elliptical cartridge

K&L Price $440.00

SYS ROT dyna SHU

ROT mea tort DY freq DU bas SH

K

We are not responsible for typographical errors.

Hours: Mon.-Thurs. 10-10 Fri. 10-9, Sat. 10-5

We are not your stereo-typed stereo store!

K+L SOUND SERVICE K+L SOUND SERVICE K+L SOUND SERV

Receivers

Scott R33S	165.00
Sansui 881	400.00
Sansui 771	319.00
Sansui 661	259.00
Concord CR-50	89.00
Superscope R340B	125.00
C/M Lab RR805	400.00
Pioneer SX-939	400.00
Sansui 8080	479.00
Sansui 9090	529.00
Sansui 331	149.00
Scott R36S	225.00

Speakers all prices per pair

AR 2AX	230.00
Dynaco A-40XL	200.00
Dynaco A35	165.00
Dynaco A-25XL	150.00
Jensen 22	150.00
Jensen 23	180.00
Jensen 24	270.00
Jensen 16	50.00
Jensen 2	70.00
Infinity Monitors	600.00
Onkyo 20	300.00
Onkyo 25	375.00
KLH 17	120.00
Pioneer Project 60	85.00
Pioneer R-500	225.00
Rectilinear XI	140.00
Rectilinear XII	225.00
Rectilinear Mini III	135.00
Rectilinear IIIa	400.00
Scott S-11D	165.00
Scott S-15	135.00
Scott S-52	140.00
Scott S-42	100.00
Sansui LM 220	225.00
Scott S16	60.00
AR 7	160.00
AR3a	425.00
Altec 874a Segovia	300.00
Altec 886B	170.00
Altec 3840	150.00
AMS 37	35.00
Cerwin-Vega 24 Factory seconds	200.00
Cerwin-Vega 12T damaged cabinet	400.00
KLH 31	85.00
ESS Tempest 3E Damaged cabinet	125.00
Fulton FM160	100.00
Fulton FM180	150.00
Pioneer Project 100B	120.00
Ohm G w/equalizer	525.00
Ohm F	775.00
RTR 280DR	400.00
Onkyo 8	135.00

Turntables

Thorens TD-165C w/Audio Technica AT-13-E	155.00
PE3044 w/wood base + cover	89.00
PE3046 w/wood base + cover	105.00
PE3048 w/wood base +cover	119.00
BSR 2620W	80.00
BSR 2510X	60.00
BSR 2260	45.00
AR XB	99.00
Garrard Z100C w/Audio Technica AT-13Ea	129.00
Fisher MT6010	85.00
Glenburn 2155A	50.00
Sansui SR-313 w/AT13Ea	139.00
Sansui FR3080	140.00
Technics SL-1100A	245.00
Technics SL120A w.o. arm	175.00
Sony PS-4750	225.00
Sony PS-5520	139.00

Cartridges

Audio Technica AT-11	15.00
Audio Techica AT-11E	17.00
Audio Technica AT-13E	30.00
Audio Technica AT-14Sa	44.00
ADC VLM	34.00
ADC XLM	38.00
Grado FTR +1	8.00
Grado F3+	15.00
Empire 2000E II	20.00
Pickering XV15/400E	18.00
Shure M91ED	20.00
Shure V15 II	58.00
Stanton 500E	15.00
Stanton 681EE	15.00
Supex +Grace Also Available	

Cassette Decks

Pioneer 7171	275.00
Pioneer 6161	225.00
Pioneer 5151	200.00
Dual 901	349.00
Akai GXC 710D	295.00
Fisher CR5010	150.00
Fisher CR5020	295.00
Technics R625US	240.00
Superscope CD-302A	130.00

Reel to Reel Decks

Pioneer 1020L	450.00
Pioneer 1011L	400.00
Akai 4000DS	225.00
Akai 4000DB	275.00
Dokorder 7100	320.00
Akai 4400	320.00
Akai 1722	280.00
Akai GX630DSS	750.00
Sony TC756	640.00
Teac 2340R	529.00
Teac 3340S	875.00
Teac 5300	512.00

8 Track Decks

Wollensak 8058	129.00
BSR TD8SW II playback	30.00
Sony TC-258 4 channel playback	89.00

Portable Cassettes

Sony CF-310	110.00
Sony TC-90	85.00
Wollensak 4350	65.00
Wollensak 402K	100.00
Superscope C-104	80.00
Superscope CR-800	66.00
Wollensak 4150	39.00

Supersc Supersc Panason Panason Panason Panason Sankyo

Dynaco Dynaco Dynaco Burwen Pioneer

Sony ST Sansui Rotel RT Scott 43 Sansui Sansui Sony ST Sony ST

Sony TA Sony TA

ER WANTS YOU

VE SAVE SAVE

THE HIGHEST QUALITY

Cerwin-Vega

eloped, literally from the ground up, to set new standards for high performance
ur precision transducers combine in an acoustically and aesthetically correct en-
ith unerring accuracy, definition and transparency.
design, simply put, calls for the woofer to be loaded into the cabinet so that its
woofer to couple with the room better, allowing lower bass response and less in-
uencies. A 15 inch woofer with a 12 pound magnet insures flat bass response as
reproducing music as low as 13 cycles.
its are arranged on the front panel at ear level for greater dispersion and stereo
nooth, phase accurate transition is made to the 5 inch polished aluminum super-
mped 1 inch dome reinforced with carbon fibers and operating a shallow expo-
develops super definition, high sensitivity, and output that is virtually undim-

sufficient to provide flat on-axis response from a properly adjusted 15T. How-
tal energy response and enhance the subjective sound character of the 15T, a
frequencies above 2,000 Hz. from room surfaces behind the enclosure. This re-
n the system control panel to whatever degree suits individual tastes and room
provides adjustments for the front mid and high frequency drivers, allowing re-
to a wide variety of conditions.
icient home speakers available, and will perform cleanly at moderate levels with
r power. Thus, its 150 watt continuous program power capacity gives the 15T
lly any other residential speaker system not manufactured by Cerwin-Vega.

magnet • 8" mid-
rn mid-range • 5"
frequency response
inus 3dB • 103 dB at

the most popular model in the en e line. This popularity can
design requirements incorporatec luring its conception. The
vanted a speaker system efficient nough to transform a 50
g more like a 200 watt receiver. Th s speaker had to produce
than even the large control room r onitors used in recording
time have a price tag under $150.00
represents the same dedication to clean, effortless sound
diophile models. A six pound magnet keeps a tight grip on the
racy and definition never believed possible in a moderately
sent is the exclusive Cerwin-Vega dhorm tweeter, responsible
y of treble frequencies necessary for a lifelike reproduction.
s undeniable, you owe it to yourself to hear this amazing loud-

magnet • dhorm
onse 33-22,000 Hz.
at 4 feet

POWERFUL enough to drive even the most inefficient loudspeakers to dramatic levels of distortion-free performance. Clean enough to bring out the full performance capabilities of the most sophisticated audiophile equipment. And rugged enough to be used night after grueling night by touring musicians and sound contractors.

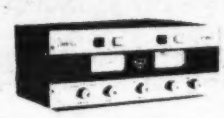
Never before have these three sometimes contradictory design goals been achieved as successfully as in the new Cerwin-Vega A-1800 and A-3000 series of stereo power amplifiers. Developed through several years of intensive research and field testing, and backed by the Cerwin-Vega reputation for powerful performance and day-in, day-out reliability, these units are destined to become the new standard setters in their respective power classes.

Our engineers have observed carefully the special problems of past high power amplifier designs (particularly in the areas of stability, output protection, crossover notch distortion, and reactive load handling), and taken special steps to design circuits that are perhaps the most misbehavior-proof on the market today. The experience of building nearly a thousand units (both A-1800's and A-3000's) for the Sensurround (TM) equipment used with the film EARTHQUAKE provided much valuable data on further improving the stability, reliability, and serviceability of the circuitry.

The specifications of the A-1800 and A-3000 speak for themselves. Note particularly the extraordinary low figure for IM distortion, which is generally recognized as correlating better with listening tests than any other type of nonlinearity (including harminic distortion). The fact that this vanishingly low level of IM is maintained at fractional watt output levels is an indication of the absence of crossover notch (the principal cause of that is sometimes called "transistor edge"), and the sweet, open sound of the amplifiers at any listening level is all the confirmation your ears will need.

Cerwin-Vega
POWER AMPS

1800



3000

SPECIFICATIONS: A-1800

Power Output: 225 watts RMS/channel, 20-20000 Hz
IM Distortion (60 & 7000 Hz 4:1): less than 0.01%, 500 mW-225 watts
Sensitivity: 1.5V RMS
Input Impedance: 10K nominal
Hum & Noise: less than 1 mV (80 dB below 10 watts)
Stability: unconditionally stable with any load or source impedance
Controls: Gain (each channel), AC power switch
Protection: Tri-Tangential VI limiters (2), DC supply fuses (4), AC line fuse, thermal cutout breakers (2)
Output Connectors: Five-way binding post
Indicators: Pilot light, LED indicators for 7% and 100% power (each channel)
Finish: anodized aluminum, black with bright lettering
Size: 19 in.W x 8 in.H x 11½ in.D (fits standard 19 in. racks)
Weight: 33 lbs.
Price: $599.50

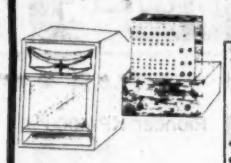
SPECIFICATIONS: A-3000I

Power Output: 365 watts RMS/channel, 20-20000 Hz
IM Distortion (60 & 7000 Hz 4:1): less than 0.01%, 500 mW-365 watts
Sensitivity: 1.5V RMS
Input Impedance: 10K nominal
Hum & Noise: less than 1mV (80 dB below 10 watts)
Stability: unconditionally stable with any load or source impedance
Controls: Gain & Crossover Mode (each channel), AC power switch
Crossover Frequency: 250 Hz Standard, others on special order
Protection: Tri-Tangential VI limiters (2), DC supply fuses (4), AC line fuse, thermal cutout breakers (2)
Output Connectors: Five-way binding post
Indicators: Pilot light, dual VU meters, dual proportional incandescent indicators
Finish: Black & brushed anodized aluminum
Size: 19 in.W x 8 in.H x 11½ in. D (fits standard 19 in. racks)
Weight: 50 lbs.
Price: $1,195.00

PA SYSTEM

K&L Sound also carries a complete line of professional audio equipment. Always the finest prices on amps, cabinets, mikes mixers and much more

CERWIN-VEGA V-35 Full Range P.A. Cabinet — • 18" woofer • Radial horn • 2 Piezo super tweeters • handles 300 watts RMS • frequency response: 35-20kHz.
CERWIN-VEGA A-1800 power amp — • 225 watts RMS per channel (measured at 8 ohms. 20-20,000 Hz. below 0.25% distortion)
SOUND WORKSHOP 882 P.A. Mixing Console — • 8 input, 3 output • mic/line inputs • low Z bal. mic. inputs • solo, mute, mon. send, echo send, and paning.

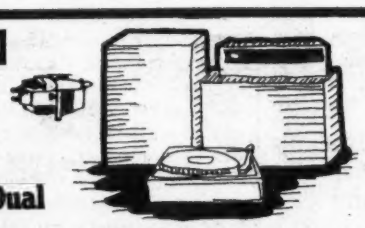


K&L PRICE $1920

Complete P.A. Systems From $1,000
WE OFFER COMPLETE PRO AUDIO SERVICES
•Custom Cabinet Design
•Custom Cross Over Design
•Electronics Modifications
• Loudspeaker Reconing
•Loudspeaker Testing
•Room Equlaization
•Custom Road Cases
•Complete Selection of 4-channel Decks

SYSTEM 750

ROTEL
dynaco INC.
SHURE Dual

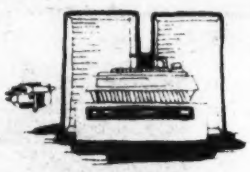


ROTEL RX-402 — • 25 watts RMS per channel measured at 8 ohms, 20-20,000 Hz. below 0.5% distortion)
DYNACO A-40XL — • 10" woofer • dome tweeter • frequency response 36-20,000 Hz.
DUAL 1225 — • damped cue • anti-skate • wood base
SHURE M91ED — • magnetic elliptical cartridge

K&L PRice $525.00

SYSTEM 802

ONKYO
B·I·C
audio technica



ONKYO TX-330 — • 17 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz. below 0.5% distortion)
CERWIN-VEGA 24 — • 12" woofer • dhorm tweeter • frequency response 33-22,000 Hz.
B.I.C. 940 — • belt drive synchronous motor • damped cue • wood base
AUDIO TECHNICA AT-13E — • magnetic elliptical cartridge

K&L Price $610.00

SYSTEM 1053

AKAI
audio-technica.
ALTEC Technics by Panasonic

AKAI AA-1030 — • 30 watts RMS per channel (measured at 8 ohms, 20-20,000 Hz. below 0.3% distortion)
ALTEC 7 — • 12" woofer • 4" mid-range • 2" tweeter • frequency response 33-20,000 Hz
TECHNICS BY PANASONIC SL-1500 — • direct drive synchronous motor • speed strobe • variable pitch
AUDIO TECHNICA AT-13Ea — • magnetic elliptical cartridge

K&L Price $799

ERVICE SOUND SERVICE SOUND SERVICE

75 N. Beacon St., Watertown
Tel. 787-4073
All units are subject to Prior Sale
Don't forget to call & make sure you're getting the lowest price!

Superscope C101A	40.00
Superscope C106	80.00
Panasonic RQ432	70.00
Panasonic RQ446S	85.00
Panasonic RQ212DAS	70.00
Panasonic RQ309AS	35.00
Sankyo ST-210	35.00

Pre-Amps

Dynaco PAT-5 kit	175.00
Dynaco PAT-5 wired	225.00
Dynaco PAT-4 wired	140.00
Burwen SP-5200	350.00
Pioneer SPEC-1	350.00

Tuners

Sony ST-5150	225.00
Sansui TU-7700	240.00
Rotel RT-1220	200.00
Scott 431	150.00
Sansui TU-4400	152.00
Sansui TU-5500	213.00
Sony ST-5055	145.00
Sony ST-5066	120.00

Intergrated Amps

Sony TA-1150	225.00
Sony TA-1066	125.00
Rotel RA-810	200.00
Rotel RA-1210	250.00
Fisher CA210	100.00
Dynaco SCA80Q	215.00
Dynaco SCA80Q kit	139.00
Pioneer SA-5200	95.00
Sansui AU4400	150.00
Sansui AU5500	225.00
Marantz 1150	300.00
Sansui AU2200	99.00

Power Amps

Dynaco ST-400 kit	400.00
Dynaco ST-400 wired	500.00
Pioneer SPEC-2	600.00
Martex PM Stereo 200	275.00
Martex PM Stereo 50	150.00

Headphones

Technics EAH-80A	50.00
Avid 88S	8.00
Koss Pro 4AA	35.00
Koss HV1A	33.00
Koss HV1	27.00
Koss SP3SC	10.00
Koss ESP 9	120.00
Audio Technica AT-701	25.00
Audio Technica AT-702	30.00
Audio Technica AT-703	42.00
Pioneer SE205UP	15.00
Pioneer SE505UP	36.00
Sennheiser HD-414	29.00
Pioneer SE405UP	27.00
AKG K-180	34.00
Koss K-7	12.00
Koss Technicians/VFR	53.00
Pioneer SE305UP	25.00
Pioneer Monitor 10	42.00
Sennheiser HD-424	49.00

Cassette Tapes

BASF C-60CR	1.75
BASF C-90CR	2.00
BASF C-120CR	3.75
BASF C-60LHS	1.75
BASF C-120LHS	3.00
BASF C-120 LH	1.75
BASF C-60 SKLH	90¢
BASF C-90 SKLH	1.00
Scotch C-90 LNHD	3 for 5.00
Scotch C-60 CR	1.75
Scotch C-45 CR	1.00
Scotch Classic C-90	2.75
TDK C-60SD	2 for 3.00
Memorex C-30 LN	50¢
SAI C-60	60¢
SAI C-90	90¢
SAI C-60XL	75¢
SAI C-90XL	1.00
Ampex 370 buy 2 for 3.98 and get 1 free and a free storage box	

Reel to Reel Tape

Ampex 20/20+ 7x1800'	2 for 6.00
BASF DP26 7x2400'	4.00
BASF TP18 7x3600'	6.00
BASF SP600 5x600'	1.00
BASF SP1200 7x1200'	2.00
BASF SP-1800 7x1800'	2.00
BASF SP1200 Bulk Erased 7x1200'	1.00
Scotch 212 R-90	2 for 7.00
Scotch Classic R-90	5.00 ea
TDK L1800	6.00 reel

Car Cassette Players

Audiovox C989 auto reverse	70.00
Audiovox C-992 FM	75.00
Craig 3504 auto reverse floor mount	85.00
JIL 604 AM/FM	100.00
Audiovox C984	100.00
Muntz M650	90.00
JIL 603	75.00
Teac AC-5	100.00
Pioneer KP 4000	136.00

Car Radios

Audiovox C577	80.00
Audiovox FMX-50 FM only	70.00
JIL MPXU	65.00
Pioneer GX-1500 mono	68.00

Car Speakers

Jensen 5¼ 20oz.	25.00
Jensen 5¼coax	44.00
Jensen 6x9 coax	44.00
Craig 8414	14.00
Craig 9433	9.00

Accessories

Sansui RA-500 Reverb	110.00
Sony NR 115 dolby	90.00
Burwen DNF 1201 Noise Filter	230.00

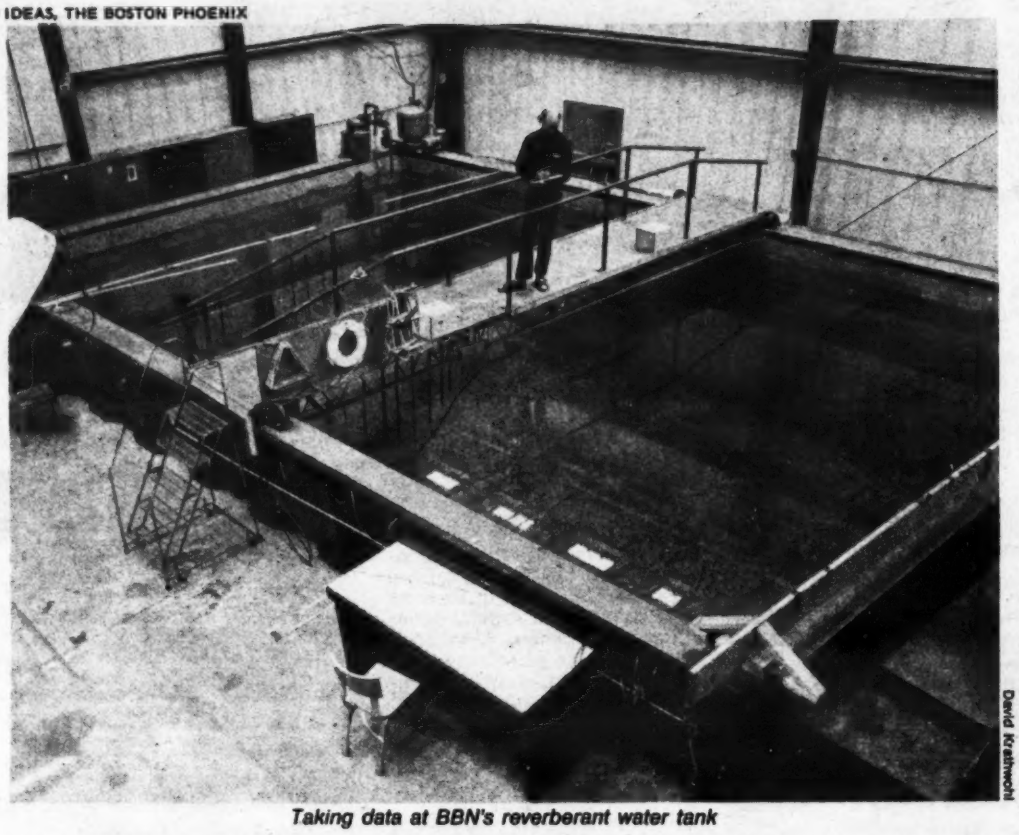
BBN

Continued from page 14

ernment standards, but an impressive indicator of BBN's involvement with Uncle Sam.

Obvious suspicions are raised by facts like BBN's closing its office in Singapore last year because, according to the 1975 annual report, ". . . a major contract for geomarine exploration in the Gulf of Siam was canceled and the political situation in Southeast Asia prevented the development of our anticipated markets." It's difficult to pinpoint exactly what's behind those references, but to some they sound bad.

On the other hand, BBN has done battle on the side of the angels. Richard Bolt was appointed by the Special Prosecutor's Office to head the investigation of the altered Nixon tapes. Rose Mary Wood was given lie to right here in Cambridge, where the original tapes were brought for a few days of preliminary testing.



David Kaltmohl

Taking data at BBN's reverberant water tank

BBN was chosen, first, because Richard Bolt is considered to be one of the foremost authorities on sound in the country, and secondly because since Bolt controls his own business he could make the politically dangerous decision to do the testing at the BBN facilities. It's rumored that Bell Laboratories, who operate one of the largest electronic testing operations in the universe, were more than a little reluctant to take on the job. So it was decided, and a team of Secret Service agents drove up from Washington in a Rambler station wagon carrying a cardboard box of tapes and Rose Mary Wood's broken tape recorder.

Since then, BBN has picked up a handful of similar jobs. The company analyzed tapes of the Kent State shootings for the Justice Department and were able to determine who fired the first shots, where they came from and what kind of guns were used.

Be all that as it may, BBN's acoustical testing and measurement facilities are straight out of Buck Rogers. Big, expensive toys are everywhere, and the BBN employees, mostly young MIT grads who fell for the line about "beating the Russians with solid state circuits" or the line about "the technology that got us into this mess can get us out" back when they were in high school, all love to play. And if a customer is of a mind to do his own testing, the facilities are for rent at day rates ranging from a paltry $100 for the anechoic chamber to $600 for the large wind tunnel and its operator.

The following is a brief catalogue of of the BBN funhouse:

The Anechoic Chamber. "Anechoic" means "No echoes." More than just a soundproof room, an anechoic chamber is a "dead" room. So dead, in fact, that if you put two people inside and close the door they can only hear each other talk when they stand face to face. Sound does not bounce around as it does in normal rooms.

BBN's anechoic chamber is a dank little cell lined with dirty pink fiberglass sound-absorbing wedges. The walls are designed to absorb more than 99 percent of indirect sound energy above 400 Hz.

The chamber has a variety of uses, among the best known being to calibrate microphones and measure the on-axis response of loudspeakers. In either case pure tones are beamed from a loudspeaker toward a microphone. Since the room is dead, the microphone receives the sound once and only once. Volume is measured and graphed automatically at a remote location by a machine that sends and receives sound through the chamber. This procedure can tell you one of two things — how the loudspeaker is behaving or how the microphone is responding. One component is always a known quantity. Such measurement produces those dB vs. Hz graphs that stereo salespeople use to sell products.

Reverberant Rooms. These rooms are designed to produce the opposite effect of an anechoic chamber. Sound bounces everywhere here. As far as loudspeakers are concerned, this facility can be used to measure the output capability of a unit under circumstances more closely resembling a living-room — if you believe that the acoustics of your living-room are closer to those of Boston Garden than to the anechoic chamber.

The reverberant rooms have other uses. BBN has two such rooms, which share a common portable wall. Take a section out of the wall and install a hollow core door and you can measure the amount of racket that leaks form one room to another. By this method you can conclude that a cardboard partition is an insufficient means of isolating a machine shop from a library, or other less obvious solutions to soundproofing problems.

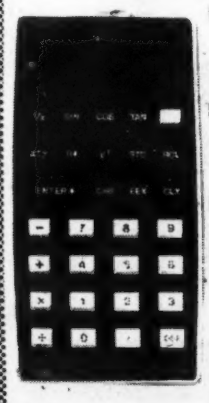
Currently, BBN is housing an incredible-looking conveyor apparatus in one of its reverberant rooms. Somewhere in West Virginia, at this very moment, a coal miner is being deafened by a similar piece of machinery, which is no surprise, since the conveyor operates by dragging steel belts across steel tracks. BBN has been commissioned to shut the thing up.

Scott Robinson, the man in charge of BBN's acoustical testing facilities, explains that this mine machinery job is typical of the type of noise-reduction projects handled by BBN. In most cases, BBN dispatches a field team to the site of the problem — for example, a team of engineers crawled into a mine shaft somewhere and made high-quality tape recordings of this monster in operation. The tapes are then analyzed, the sound broken down and measured at vari-

Hewlett—Packard's *Bonus Packages*

We've got it!

The great new Hewlett-Packard HP-21 Scientific Pocket Calculator. Uncompromising quality at only $125.



- ☐ **A true scientific calculator with** 32 functions and operations, including rectangular/polar conversions, register arithmetic, two trig operating modes.
- ☐ **Full display formatting.** Select fixed-decimal or scientific notation with display rounded to desired number of decimal places.
- ☐ **HP's error-saving RPN logic system with 4-memory stack.**
- ☐ **Traditional HP quality craftsmanship.**
- ☐ **New, smaller size.**
- ☐ **An unbeatable price/performance ratio.**

Test the new HP-21 today right in our store. See for yourself how much performance you can take home

FREE OFFER

* when you purchase your new HP-21 Scientific calculator before March 15, 1976, you are entitled to a free copy of our new HP-21 Applications Book. This 116-page handbook gives you 50 valuable applications to help you get the most from your new HP-21.

The World's Most Remarkable Scientific pocket calculator. The Hewlett-Packard HP-65

The HP-65 fully programmable pocket calculator provides a 100-step program memory, 9 addressable data memories, and 51 keyboard functions and operations. You can operate it from the keyboard, program it yourself, or use it with pre-recorded magnetic program cards available in such fields as electrical engineering, mathematics, statistics, finance, navigation, and surveying.

When you purchase an HP-65 before March 15, 1976, you receive a $195* Bonus

* receive FREE with the calculator, a coupon for the delivery of 4 application pacs and 5 users Library Programs of your choice.

Available At:

CALCULATOR SHOPS

BOSTON — 119 Comm. Ave.
BOSTON — 40 Bromfield St.
WORCESTER — 222 Main St.
BRAINTREE — South Shore Plaza

ous spectral bands and solutions are offered to the client.

Noise reduction treatments fall into three categories. Robinson explains, "We either modify the source, the path or the receiver of the noise. In this instance the easiest solution is to have the miners wear earmuffs, but they refuse because they like to listen to the sound of the roof collapsing. We can't isolate the machine from the miners so we're modifying the machine itself."

Wind Tunnels. BBN has worked on the design of every major acoustic wind tunnel in the country and has two of its own in its Fresh Pond Building — a low-speed wind tunnel that can move air as fast as 120 feet per second, and a diesel-powered high-speed tunnel that can move air at 300 feet per second. These tunnels are hardly used for stereo testing, but they are ideal for working with airplane wing sections and simulating the effect of wind on models of tall buildings. For example, BBN has measured the inaudible sound vibrations produced by the New England Merchants National Building in Boston, to determine the effects of moving air upon the structure and the effects of the structure on the moving air. Two opposing buildings produce a very low frequency whistle between them as the wind shifts back and forth. Measuring this before a building is constructed helps architects select building materials and design the shell of the buildings to meet the projected wind load. All of which is just another way to say the building won't fall down.

Underwater Sound Laboratory. A major feature of BBN's underwater facility is a calibrated 14 x 22 x 33-foot swimming pool. The pool is designed so that no two facing walls are parallel, so BBN experimenters can direct and measure sound under water. The U.S. Navy is a big customer here. BBN has researched the sounds made by moving torpedos (using a full size torpedo), as the Navy is very much interested in having its weapons make as little noise as possible. In fact, torpedos, ships and submarines can be identified by what is called their "radiated-noise signatures," and every Navy in the world is frantically trying to redesign its equipment so the other guy won't know what's going to kill him.

Concert Hall Design. Robert Newman points with self-conscious pride at the ventilator in his office. "I think that control of our everyday environment is more important to people than building a good concert hall. That ventilator is making a noise. You may not have noticed it. It's not loud but it's actually protecting us from noise outside this room."

Newman (the N in BBN) is an architect by profession, and very much enamored of the idea that we have the technology to make our homes and offices more livable. Newman's office is located in a Waltham industrial park where part of the overflow from BBN's Fresh Pond building is camped until the company's new Cambridge facility is habitable. BBN didn't design the Waltham site, so it's just a matter of luck that Robert Newman has a quiet ventilating system.

His home, however, is a different story. A few years ago word got out that Newman's house was a technological showplace, and the inevitable writer from *Playboy* showed up on the doorstep, randy to report on all the gadgetry. Wrong.

Newman explains, "The technology in my home is hidden. People who build new homes are always coming to me and complaining because their houses are noisy. They build plaster ceilings, hardwood floors and glass walls and what can they expect?

David Kraftwohl

Adjusting instruments in the reverberation room during tests of a coal-mining machine

I've designed the acoustics of my home so that it's livable. You can carry on a conversation in the room with the dishwasher while it's running. My kitchen is a dead room. The noise of appliances stays with the appliances. The fan in the bathroom ceiling is silent. I have a very powerful ventilating fan above the kitchen stove and nobody every hears it. It's a matter of considering how sound works when you make the design. We have all the technology we need to control noise levels by design."

The same technology applies to concert hall construction. Newman's obsession with ventilating systems is no mere eccentric quirk. Concert halls need fresh air, and fans make noise.

A few years ago, BBN redesigned the ventilating system for Boston's Symphony Hall. As part of the design they lined the ducts with fuzz (sound absorbing material), kept the fan velocities low and isolated all the motors and machinery on spring-mounted platforms.

BBN has a lengthy list of concert hall credits, including Boston's Symphony Hall, the Hopkins Center at Dartmouth, Lincoln Center, Kresge Auditorium at MIT and the Loeb Drama Center at Harvard. They've also designed the acoustics or consulted with architects on such projects as the Houston Astro-

Continued on page 20

Sound gatherer...music giver.

Music is the color in your life. Make sure you get all the color. Record on The Music Tape™ by Capitol. It's the premium blank tape made especially for recording music with all of its color. If we didn't believe it was the finest tape for music recording and playback, we wouldn't put our name on it.
The Music Tape by Capitol.

Now you can buy blank tape confidently, without confusion, without being a sound engineer. We've simplified the coding, the grading, the packaging, the whole business of buying blank tape. Now it's this simple: When you record ordinary things, use our ordinary tape. But when you record music, record on *The Music Tape* by CAPITOL, cassette, cartridge, open reel, *The Music Tape* by CAPITOL is the best blank tape you can buy for recording music. It's made in one grade only — extra high output/low noise tape for full dimensional sound.

GUARANTEED JAMPROOF

The Music Tape by CAPITOL has our exclusive cusion-aire T.M. backcoating. Its benefits are many. But most importantly it prevents jamming.

Available wherever fine quality tape is sold

BBN

Continued from page 19

dome, WGBH-FM studios and Motown West Studios.

Robert Newman explains that BBN approaches a concert hall design project in three stages. The first step is to make the room in question impervious to noise from the outside. This has a lot to do with the building material. Simply stated, heavy walls insulate better than thin walls. The major problem comes with ceilings and doors.

Ideally, a concert hall ceiling should be suspended at least ten feet below the roof of the building, but this is possible only with thick-shelled structures. Doors are a bigger headache because you can't expect concertgoers to push their way through two-ton portals to get to their seats. Whenever possible, acoustics specialists try to design a sound lock at entrances. A sound lock is a dead air space.

Newman explains, "Sound is nothing more than changing air pressure moving at 1120 feet per second. The air can vibrate your eardrums so you can hear me talk and it can vibrate wall materials. The amount of sound that gets through a wall depends on how much the wall moves when the air pressure changes. A series of two facing doors is more efficient than one heavy door. In principle it works like two steel balls connected by either a steel rod or a soft spring. One door is like a steel rod — you move one ball and the other follows, but with the spring the energy is absorbed between the two steel balls."

BBN has done some remarkable things with this principle. The Loeb Drama Center at Harvard has a shop where students can build stage scenery — using even hammers and power saws — while a performance is going on in the adjacent theater. That scenery is isolated from the theater right down to the foundation, with six inches of dead space between it and the rest of the building.

The second step in designing a concert hall is to determine what is going to go on in the room after it's built. Newman says that most concert facility owners begin by saying they want a pure concert hall — then later they admit that they're going to use it for film festivals and dance recitals. These factors have a lot to do with how a hall is designed. Movies require a narrower audience field of view than symphony performances. Dance performances mean that every seat in the house has to be able to look at the performers' feet. These are little things that make a big difference, for what people hear in a large auditorium depends upon where they sit.

Newman gives a classic example of the Berlin Philharmonie. Just to be different, or for whatever reasons, the people in charge of building that hall decided that the audience should surround the orchestra "like people sitting on a hillside above a beautiful vineyard" (?). Anyway, it didn't work, for an obvious reason: sound is directional, especially that sound projected from a soloist.

The third phase of acoustical design involves formulating the maximum reverberation time, that is, the longest time it takes for a sound to travel from the stage to the audience. A certain amount of delay is desirable to round out the sound, but after a certain point the sound that's reflected from the walls or ceiling ceases to be a complement to the sound traveling directly from the stage and begins to become an irritating noise. Too long a reverberation time (too many reflections) can result in a concert hall where the music sounds like it's being played in the Lexington High School gymnasium. This time-delay is plotted against the capacity of the hall to determine the height of the ceiling. According to Robert Newman a hall seating 2500 to 3000 people usually ends up requiring a 70 to 80 foot high ceiling.

If BBN is working with an existing space and needs to modify the acoustics, they often effectively lower the ceiling by hanging panels (or clouds) above the stage or audience. These panels reflect the sound and are often used in new installations to even out the sound at various parts of the hall.

BBN uses sound-absorbing materials as little as possible except as a corrective measure. In one instance, however, the Warner Concert Hall at Oberlin College in Ohio was designed with drapes of fabric along the side walls which can be opened and closed to change the acoustical properties of the room between reverberation times of 1.2 seconds to 2.3 seconds to adjust for different types of performances.

Another consideration for acoustical designers is on-stage communication. Members of the orchestra have to be able to hear each other while they are playing. Symphony Hall in Boston has a near-perfect 65-foot-high ceiling above the audience and a 42-foot-high roof over the stage. According to Robert Newman, the ceiling is fine for the audience. Symphony Hall has what they call good "early reflections" which produce a well-articulated sound throughout the hall. But the hall has also a huge open area above the stage, which tends to fill out the sound in the orchestra seats. The audience doesn't mind, but the musicians would hear each other better if the on-stage reflections were shorter. Tanglewood, for example, has a 25-foot reflecting surface positioned above the stage.

At one point, people from BBN went in to Symphony and hung reflectors above the stage during a recording session. It sounded great on stage, but the clouds were hideous and obscured the view for people sitting in the side balconies.

Robert Newman recently met with backers for a new concert hall now being built in Toronto. When they asked him how BBN did its testing, Newman answered "in full scale." Which, he claims, is the only way to do it. Every designer needs a Lincoln Center.

Newman concludes, "It's not necessary to make mistakes, but it certainly speeds the learning process."

If all loudspeakers were tested with a square wave, only one we know of would pass.

Ours. Our new Phase-Link™ loudspeakers would pass this demanding test because they do not exhibit the phase distortion present in most conventional loudspeakers. Phase distortion is one of the reasons you do not see a square wave being used to test speakers; cartridges and amplifiers, yes, but not loudspeakers.

Phase Distortion Explained. Phase distortion is heard as a blurred sound picture and prevents accurate localization of instruments. It is most noticeable in the low frequency range at higher volumes. It occurs in most conventional, multi-way loudspeakers at the crossover point, when the same note is being reproduced by two drivers. Because today's high quality loudspeakers have virtually solved the problems of frequency response as well as harmonic and intermodulation distortion, the study and correction of phase distortion is all the more important if you are to literally recreate the original performance.

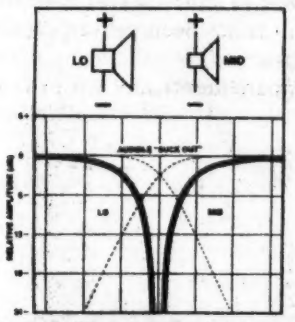


Diagram A. When drivers are placed in-phase, a problem of audible "suck out" is created.

Our Research. At the 1973 AES convention in Rotterdam, two Bang & Oulfsen engineers, Madsen and Hansen, presented a paper on audible phase distortion. This paper represented three years of concentrated research within which they developed an electronic crossover, tri-amplified loudspeaker that allowed them to demonstrate three important facts: 1. Phase distortion did indeed exist in loudspeakers. 2. That it was audible. (Hundreds of hours of critical listening tests confirmed this.) 3. That it could be effectively eliminated through sophisticated technology.

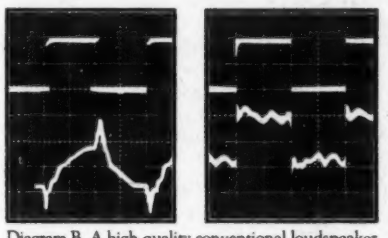


Diagram B. A high quality conventional loudspeaker (left) and our new Phase-Link loudspeaker (right) reproducing a square wave. What happens to the square wave is what happens to music.

Our Product. The experimental speaker developed by Madsen and Hansen was far too expensive to consider for distribution to the audio consumer. A practical solution had to be found.

At this point Bang & Olufsen engineer, E. Baekgaard began his work with mathematical computer simulation. He discovered that the fixed phase shift, present in most conventional speakers (drivers alternated 180° out-of-phase) could be "cured" by placing all drivers in-phase. However, when this was done, an audible amplitude "suck out" was created (See diagram A.). It was to solve this problem that an additional narrow band filler driver—the Phase-Link™ Driver— was developed. Its compensating signal cured the amplitude "suck out" and the variable phase shift. It made the audible output of the loudspeaker virtually identical to the input—the square wave, for example.

Another Refinement. Phase-Link™ loudspeakers have their drivers mounted on a common acoustic axis so that the sound from each driver will reach your ears simultaneously. Tha is the reason for our slightly canted grill

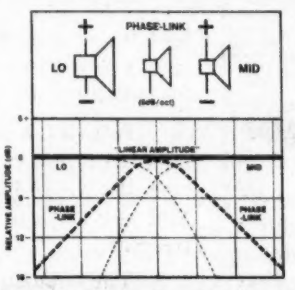
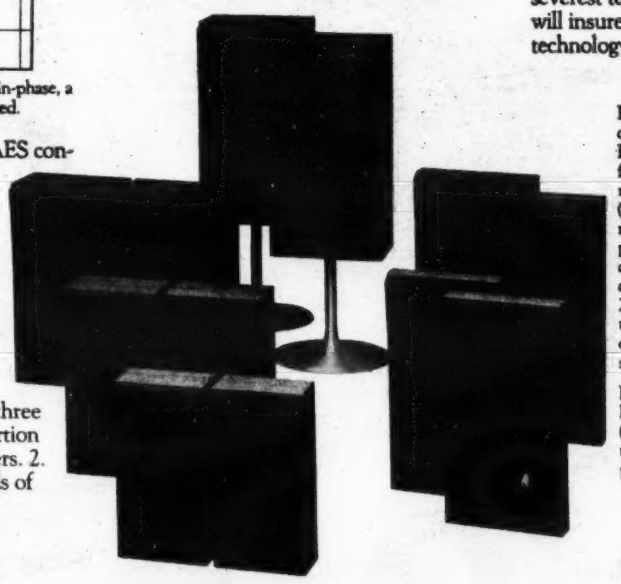


Diagram C. Our new Phase-Link filler driver provides a compensating signal to eliminate "suck out" and variable phase shift.

Your Listening Experience. The importance of our new Phase-Link™ technology and square wave tests is of course determined by the fidelity of the music recreated by our speakers. It is your sensitivity to the accurate reproduction of music that will give them their severest test. It is our technology which will insure they pass, for rarely has technology served music so well.



Because the ear is sensitive to phase distortion mainly in the lower frequencie Phase-Link is used between the low-frequency driver and the mid-range unit in the high power, 3-way systems (M-70, S-60) but not between the mid-range and tweeter. In medium-power, 2-way systems, one Phase-Link driver is used in 12dB/oct. filter combinations (S-45, P-45). Low-power, 2-way systems (S-30, P-30) do not utilize a Phase-Link driver but instead eliminate phase distortion through a sophisticated 6dB/oct. filter technique.

Bang & Olufsen speakers include the M-70, shown on trumpet stand (supplied), three bookshelf models, the S-60, S-45, and S-30, and two wall panel speakers, the P-45 and P-30.

Bang & Olufsen

Bang & Olufsen of America, Inc., 515 Busse Road, Elk Grove Village, Illinois 60007

Available At:

MASSACHUSETTS
EARDRUM
Boston • Burlington • Harvard Sq.

TWEETER ETC.
Brockton • Brookline •
Harvard Sq. • Chestnut Hill

THE MUSIC STORE
Greenfield

NANTUCKET SOUND
Cape Cod Mall • Swansea Mall
North Dartmouth Mall

MALCO ELECTRONICS
Lawrence

TRIPOD AUDIO
Northampton

NEW HAMPSHIRE
MANCHESTER MUSIC AUDIO CENTER
Manchester

RHODE ISLAND
THE LISTENING POST
Woonsocket

VERMONT
AUDIO DEN, INC.
South Burlington

CONNECTICUT
FRED LOCKE STEREO
Fairfield • Greenwich • Stratford

STEREO ONE, INC.
Fairfield

THE STEREO LAB
Groton • New London

THE RADIO SHOP
New Canaan

DAVID DEAN SMITH
New Haven

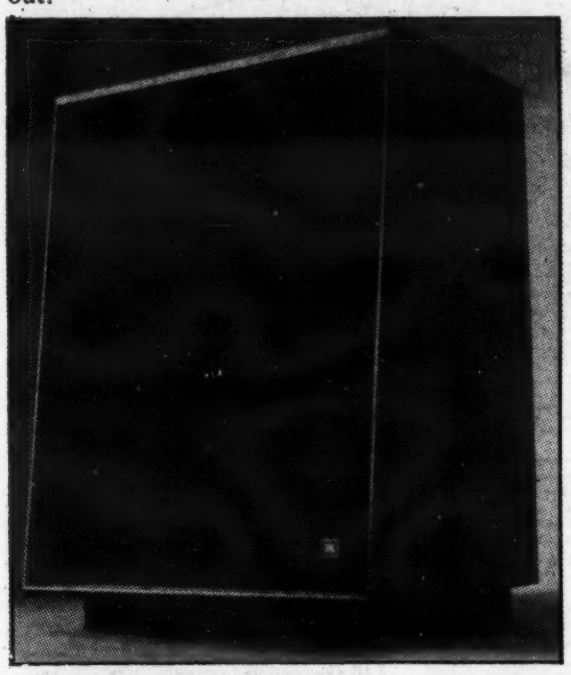
SOUNDS INCREDIBLE
Danbury

Tech Hifi's $2,734 Phase Linear, JBL, Technics and Microacoustics system.

You've Never Heard Anything Like It.

You've never heard recorded music sound like this Tech Hifi system makes it sound.

Thanks to the unique capabilities of the Phase Linear 4000 preamplifier, this system actually puts the dynamic range back into recorded music that the recording process takes out.



And because the system combines a super-powered Phase Linear 400 amplifier with super-efficient JBL L200B loudspeakers, it will play that music back for you at levels of volume that a symphony orchestra would be hard-pressed to match.

Combine a Technics SL-1300 *direct-drive* turntable with a Microacoustics QDC1-e *electret* cartridge, and the result is a system with musical reproduction capabilities of the highest calibre.

The Phase Linear 4000 is unlike any other stereo preamplifier you've ever encountered. It incorporates a Peak Unlimiter, Downward Expander and Autocorrelator to make up for deficiencies inherent in the process of squeezing the incredible dynamics of live music into the vinyl groove of a phono record. Together, they work to recreate the original dynamic range that exists in live music *prior* to the recording process, against a dead silent background.

The Phase Linear 400 stereo amplifier has the power it takes to recreate recorded music at concert hall levels without "clipping" off the very low notes, the very loud ones, or the *most* demanding musical passages where extreme low notes must be reproduced at loud volume for a sustained period.

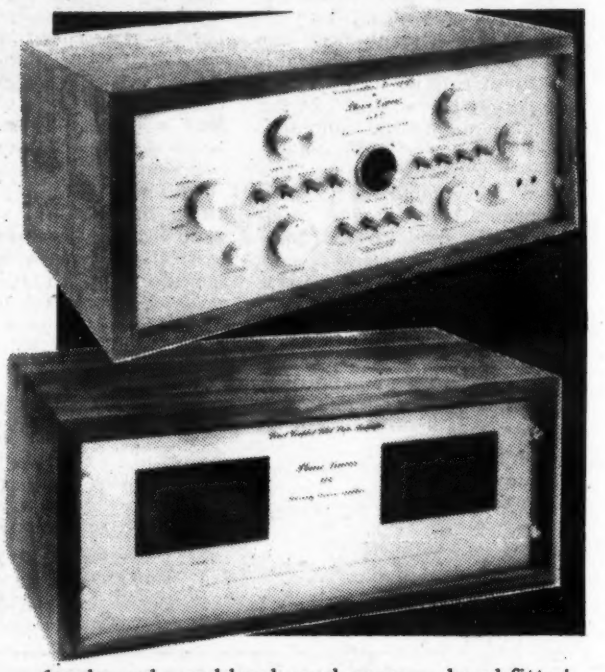
The Phase Linear 400 delivers 200 watts minimum RMS per channel into 8 ohms from 0 to 20,000 Hz. with less than 0.25% total harmonic or I.M. distortion (The more astute among you will notice that this is a very conservative figure!).

JBL L200B loudspeakers (included at the regular price of $696 each) are among the largest and most efficient available for home listening.

Low frequencies are effortlessly reproduced by a massive 15-inch long-throw woofer. Efficiency *and* dynamic range are further enchanced by two tuned ducted ports.

A high frequency compression driver coupled to an exponential horn lens delivers crystal-clear treble response with wide dispersion that you just can't expect from an ordinary tweeter.

The enclosure of the L200B is constructed of the finest furniture-quality compressed woods,



hardwoods, and hardwood veneers—hand-fitted and hand-rubbed to a superb finish. An acoustically-transparent molded grille complements the elegant cabinetry.

No other turntable than the Technics SL-1300 could possibly do justice to this system. With its low-speed direct-drive servo motor and gimbal-suspended tonearm, the SL-1300 spins and tracks your records with virtually flawless precision.

The Microacoustics QDC1-e was the logical choice as a phono cartridge for this system. It has been proven capable of producing audio signals from a record that compare identically with the master tape from which the record was cut.

Come in to Tech Hifi this week to hear for yourself how much like live music recorded music *can* sound.

Other systems on sale at Tech Hifi right now start as low as $199.

JBL *Phase Linear* Technics **ma**

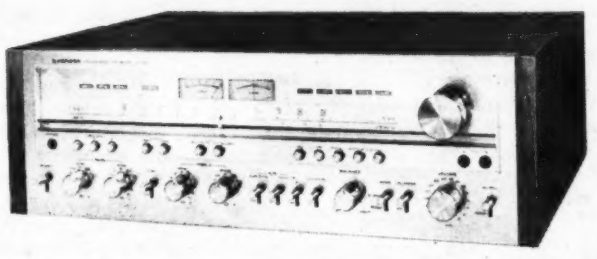
240A Newbury St., 870 Commonwealth Ave., **BOSTON** / 38 Boylston St., 182 Massachusetts Ave., **CAMBRIDGE** / Route 9, **FRAMINGHAM** / Route 1, **DEDHAM** / 835 Southern Artery, **QUINCY** / 352 Main St., **STONEHAM** / 667 Main St., **WALTHAM** / 279 Main St., **WORCESTER** / 48 Teed Drive, **RANDOLPH** / 186 Main St., **NORTHAMPTON** / 253 Triangle St., **AMHERST** / Hanover Plaza, **HANOVER** / 375 North Montello St., (Route 28) **BROCKTON** / Main St., **HANOVER, N.H.** / Nashua Mall Extension, **NASHUA, N.H.** / Stores also in Rhode Island, Connecticut, Vermont, New York, New Jersey, Ohio, Pennsylvania and Michigan.

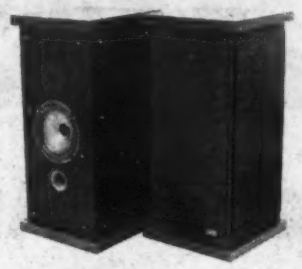
SO WHAT ELSE IS NEW?

Pioneer's Biggest Receiver

The Pioneer SX-1250 is their newest, best, most powerful and most costly (around $900) receiver. It offers:

Continuous power output 160 watts per channel minimum rms at 8 ohms, from 20-20,000 Hz, with no more than 0.1 percent total harmonic distortion; parallel push-pull direct-coupled output circuit and 2-stage differential amplifier; twin (main and sub) stepped tone controls for precision bass and treble adjustment; tone-control defeat switch for absolutely flat frequency response; provision for three sets of stereo speakers — up to two sets used simultaneously and *front panel* selectable; precision phono equalizer circuit has unusually high overload capability to handle peak signals as high as 500 millivolts; five-gang variable capacitor and three Dual MOS FETs in FM front end; dual tape monitor circuits, including tape-to-tape duplication while listening to an alternate program source; Inputs for two phono, auxilary, adapter and two microphones; multipath switch audibly indicates minimal level of multipath waves for optimum antenna position; step-type volume control is calibrated in decibels for direct readout; -20dB audio muting, FM muting, steep high and low filters, loudness control; pushbutton function selection with illuminated readout, phase-lock-loop IC circuit for stereo mpx decoding.





Avid Model 101 Column Speaker

Avid Corporation has announced the addition of a new loudspeaker, the Model 101, to its Series 100 line of hi-fi speakers. The new Model 101 speaker is a two-way, four-driver column design using a large vented enclosure for extended bass with medium efficiency. It is the result of over a year of extensive research and development. Frequency response is measured by Avid at 30 Hz to 18 kHz plus or minus 3 dB, and two-side firing auxiliary tweeters are employed to provide full 180° high frequency dispersion. The three floating dark brown grilles are removable.

The suggested retail value of the Model 101 is $139.00 (slightly higher on the West Coast), a price which Avid feels makes the Model 101 one of the best performance values available. The Model 101 carries a limited 5-year warranty, as does the rest of the Avid line.

AKG K-240: "Amazing New Pudding"

Philips Audio Division (AKG) has introduced a new circum-aural headphone, K-240, claimed to be lightest weight in this class of headset. It weighs 298 grams (10.5 ounces) total with line cord. Most significant innovation in these new stereo headphones is a combination of a main driving transducer and six passive "slave" diaphragms in each ear piece. Forty-five degrees apart, three "slaves" are situated forward of the mid-line of the transducer with three "slaves" to the rear, all placed on the main coupling wall. (The passive diaphragms are activated by sound pressure waves produced by the main driver and are said to extend and smooth out the frequency response of the total system.)

The diaphragms operate at a theoretical crossover point of 200 Hz. The acoustical resistance presented by these "slaves" provides an effect of "open listening" at frequencies above 200 Hz. Below 200 Hz the compliance of the passive diaphragms acts as a closed wall, resulting in perfect bass reproduction, matching closed headphone characteristics.

AKG claims that these dynamic stereo headphones surpass even the most elaborate electrostatic headphones in the transparency of the reproduction. The price is $69.50.

The Presage Speaker

Presage Corp. of New Hampshire announces a new loudspeaker system for about $95. The enclosure has a tuned port to reduce the excursions of the woofer cone at the lowest bass frequencies which 1) reduces distortion at the very low bass, 2) enhances the ability of the woofer to handle large amounts of power and 3) results in a significantly better efficiency than is possible otherwise. This means you can use an amplifier with a wattage as low as 10 to 13 watts.

Pioneer RG-1 Expander

U.S. Pioneer Electronics Corp. has introduced the RG-1 Dynamic Range Expander, a component which can be added to any stereo high fidelity component system to recover the musical dynamic range that is usually compressed or restricted in recordings, tapes and FM broadcasts.

The unit counters the areas of dynamic control in the recording process that produce distortion of dynamics. Recordings generally involve three areas of dynamic control — reduction of transient peaks, overall compression of loud levels and upward manipulation of soft levels. The first two techniques are used to control system overload in the recording system, while the third technique is used to raise the minimum signal above background noise levels.

The RG-1 is designed to restore dynamic accuracy in each of these three areas. It will enhance transients, add overall dynamic range and downward expand soft passages to realistic levels. This reversal of the recording process results in a close approximation of the dynamics of the original program. In essence, the RG-1 Dynamic Expander effectively restores musical dynamic range by reducing the level of soft musical passages and increasing the loudness level of louder passages. As an added benefit, the downward expansion capabilities of the RG-1 significantly reduce all noise components — tape hiss, record surface noise and background FM noise. No previous encoding or processing of program material is required.

Approx. price: $175; the component is attached through the usual tape monitoring facilities.

more than one revolution started in MASS-A·CHU-SETTS

and one of them is still going on here where we started the hi-fi revolution in 1947.

The Scott revolution contributed enough firsts to fill this page, including the first successful stereo FM tuner, the first all-solid-state components, the first digital tuner, the first four-channel components, and many more.

Start a little revolution of your own by upgrading your music system with a new Scott tuner, amplifier, receiver or speakers from the revolutionaries at Maynard, where innovation has been a tradition for over a quarter of a century. To fire the first shot, visit one of the Scott dealers below or write to us for product information.

H SCOTT® *where innovation is a tradition*

H.H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. 01754

See the fine Scott products at:

MASSACHUSETTS

ATLANTIS SOUND — All Stores
K&L SOUND — Watertown
TWEETER ETC. — All Stores
POLEP BROTHERS — Chicopee
STOP, LOOK & LISTEN — Concord
IMAGES SIGHT & SOUND — Fall River
ELECTRONICS WERLD — Framingham
GLASS SAIL BOAT — Gloucester
MALCO ELECTRONICS — Lawrence
TUNE TOWN — Lawrence
AIRPORT SALES — Leominster
METRO MUSIC — Leominster
STEREO SHOP — Marlboro
YOU-DO-IT-ELECTRONICS — Needham
TUTTUROW TV — New Bedford
AUDIO DESIGN — Pittsfield
SOUTHBRIDGE MUSIC CENTER — Southbridge
DEL PADRE — Springfield
ROYAL PIANO — Worcester
MUSIC STABLE — Marblehead

NEW HAMPSHIRE

AUDIOPHILE STUDIO — Greenland
MICHAEL'S RADIO & TV — Hanover
MACMILLEN CO. — Keene
CAMPUS HI-FI — Manchester
ASHMONT ELECTRONICS — Plaistow

RHODE ISLAND

SOUND-O-RAMA — Cranston
APEX — Pawtucket and Warwick
ATLANTIS SOUND — Providence
ED'S TV — Woonsocket

CONNECTICUT

HI-FI STEREO HOUSE — Newington
WESTCON ELECTRONICS — Bridgeport
CARSTON STUDIOS — Danbury
ATLANTIS SOUND — New Haven
ROBERT ELECTRONICS — New London
TELCOM — Norwalk
KORVETTES — Trumbull
AUDIOCOM — Old Greenwich

CITIZENS BAND ON THE RUN

by Larry Collins

What is the fastest-growing entertainment medium in the USA? Certainly not commercial television, where the more the programs change the more conspicuously they remain the same. And not porno theaters, which haven't quite achieved the social respectability required of a true mass medium.

The big boom is in CB, "citizens band" radio, which is a sort of cross between short-wave ham radio and a party-line telephone. Americans spent an estimated $700 million on CB equipment during 1975 and may double that sales figure this year. Established CB manufacturers (such as Pace, Hy-Gain, Kraco, Craig, Johnson) are hard put to keep up with the exploding demand. This year both the electronic giants (RCA, GE, Motorola) and hi-fi manufacturers (Panasonic, Hitachi, Pioneer) are jumping into CB to get a piece of the billion-dollar action.

It wasn't supposed to be like this. When the Federal Communications Commission established the Citizens Band in 1958, it envisioned a sedate supplement to existing radio and telephone services. CB radio would permit a Sunday fisherman to tell his wife when he would be home for dinner, would enable a traveling salesman to receive messages from his office while driving to his next appointment, would permit the foreman on a skyscraper construction job to talk with the crew working on the 17th floor, would enable Mom (of "Mom & Pop's Friendly TV Service") to tell Pop in the service truck where his next house call would be.

CB was intended for small business and "personal business" use — for essential communications only, not for casual conversation. On most of the 23 CB channels you were not supposed to converse with strangers; you could only use your CB radio to call another unit owned by yourself, your family, or your company. By limiting conversation to five minutes duration and transmitter power to four watts, the FCC anticipated that the 23 CB channels would be reasonably free of crowding and jamming for many years to come, especially since CB frequencies tend to be capable of only short-range, line-of-sight reception, unlike conventional short-wave radio.

But the FCC failed to reckon with the American public's love of both gadgets and gossip. What American child was not fascinated by Dick Tracy's two-way wrist-band TV, nor as an adolescent by more elaborate short-wave radio sets? CB radio, though limited to a nominal 20-mile range, provides some of the same thrill as "real" short-wave radio, without the latter's complexity. A CB radio operator was supposed to get a $20 license and use assigned call-letters, but the license application was a simple formality, with no knowledge of Morse Code or electronic theory required.

CB radio provides an interesting mix of satisfactions. When you transmit you are in every sense "on the air," broadcasting to an uncounted listening public — a very special ego trip, especially for the millions of "middle-Americans" who see themselves as consumers and victims of the commercial media and never envisioned themselves in the position of a Walter Cronkite, a John Henning or even a Charles Laquidara. But while the CB transmitter gives you a vehicle for airing your opinions publicly, it also provides an attractive security blanket in the form of anonymity. If you identify yourself by a code name instead of your assigned call letters, then you can air your views without fear of embarrassment or ridicule. This opportunity to be a public *persona* without losing privacy — to be, as it were, a masked exhibitionist — is predictably attractive.

By 1972, over two million CB licenses had been granted. Many of these were for legal users — and even praiseworthy users, such as the thousands of groups monitoring CB channel 9 for emergency calls requesting help after an auto breakdown or traffic accident. But an increasing fraction of users treat CB as a modern alternative to the old telephone "party line," with the advantage that in CB when the discussion gets dull you can switch channels and join a new group of conversationalists. All such users, of course, violate the FCC rule against non-essential communication, and some also violate rules against obscenity and libel.

About half of all CB units are installed in cars and trucks. Interstate truckers have created a new language for mobile CB, for use in exchanging notes on weather, traffic, breakdowns, and

the locations of state cops and speed traps. This trend finds its expression in the highest form of modern American myth-making, the hit song (C.W. McCall's "Convoy"). Mobile-unit installations have led the explosive growth of CB's popularity during the last two years, causing some manufacturers to suggest that CB soon will be as standard an item in cars as radios and tape players are now. Last year the FCC was literally buried under a wave of license applications; they are currently issuing CB licenses at a rate of about three million per year and are still failing to keep up with demand.

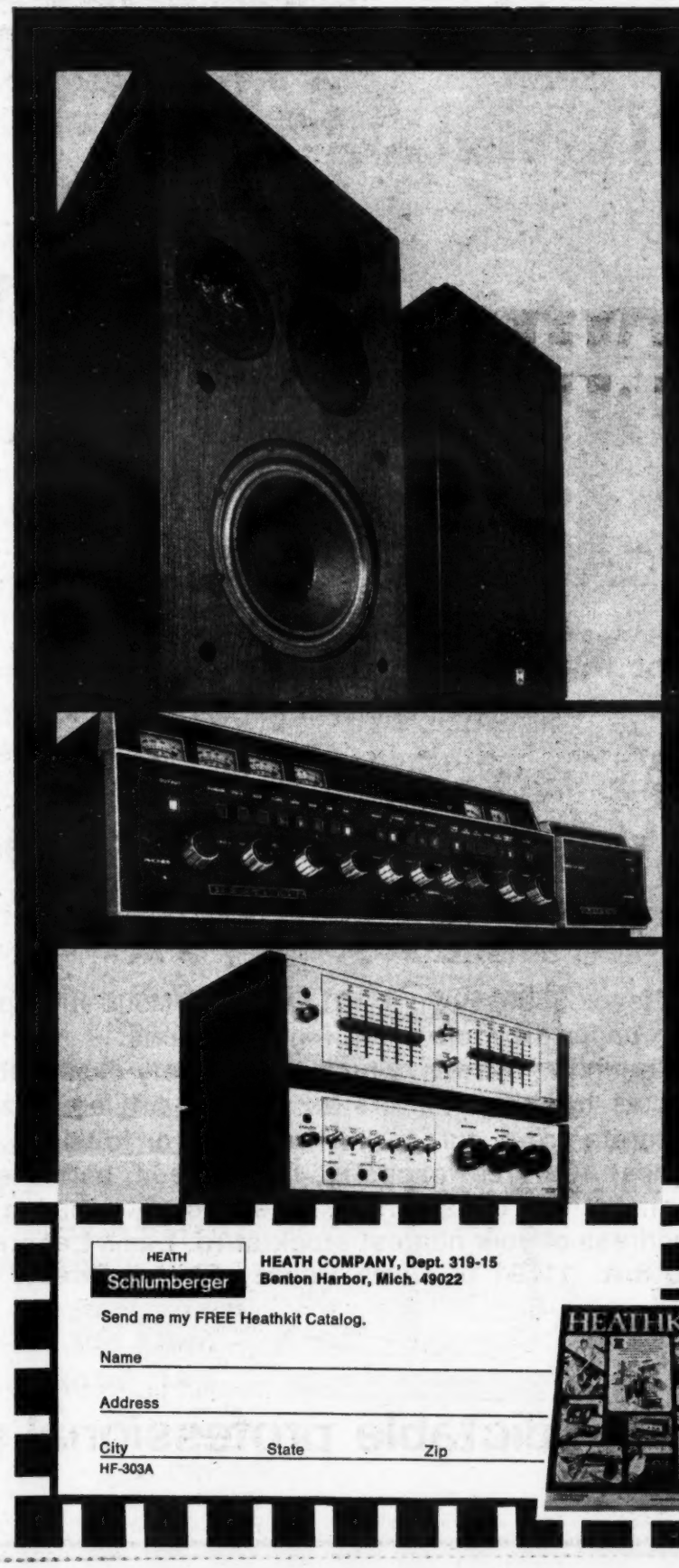
Since the old rules governing CB broadcasting have proved unenforceable, as the American public have voted with their dollars and turned the CB band into 23 channels of chit-chat, barroom argument, and highway advice, the FCC has now given in and changed the rules. The license fee has been cut to $4, and "non-essential communication" is now permitted on most CB channels. And the FCC is about to announce an expansion of the CB band from the present 23 to as many as 50 or 70 channels.

The hottest CB product of 1976, for those who can afford it, is the all-in-one unit for installation in the car dashboard. (Units that bolt on under the dash are too prone to rip-offs.) Units combining AM, FM stereo, CB, and stereo tape player (cassette or eight track) are coming from manufacturers such as J.I.L., Panasonic and other manufacturers, include AM/FM/CB radios for under $300 and CB/stereo-tape units for about $250.

At the opposite end of the price scale — and perhaps the ideal CB product if you want to judge for yourself whether CB is fascinating or dull — you can get for about $30 a Tenna CB converter that permits you to tune CB channels on your car's AM radio. Multi-band portable radios are also beginning to appear with the CB band included for the benefit of people who would like to hear what CB radio is like without investing in a transmitter. After you listen to the conversations, debates and highway advice on the several channels, you may decide to spend money for a full-fledged transceiver (transmitter-receiver).

Although there are a few six-channel CB transceivers available, most of this year's models are equipped to transmit and receive all of the existing 23 channels. This flexibility of choice is increasingly valuable now that

Continued on page 30



who builds the most exciting audio equipment in the world?...

YOU DO!

Heathkit hi-fi gives more features and performance for your money, because you build it yourself. You get all the parts you need, plus foolproof, step-by-step instructions.

At just $149.95 each, we think you can't buy a better speaker than our AS-1373.

Heathkit Modulus™ is the talk of the industry — a system that combines state-of-the-art performance with protection against obsolescence. It can be stereo now, 4-channel later — without "black box" converters. The digital-readout AM/FM tuner/preamp costs just $599.95 and matching stereo amplifiers start at $159.95.

The new AP-1615 stereo preamp is one of the world's finest, yet costs just $129.95. The matching AD-1305 five-band stereo equalizer provides exceptionally versatile tone control. It costs an incredibly low $119.95.

See the complete Heathkit hi-fi line — send for your free catalog today!

HEATH Schlumberger

HEATH COMPANY, Dept. 319-15
Benton Harbor, Mich. 49022

Send me my FREE Heathkit Catalog.

Name

Address

City State Zip

HF-303A

NEW Heathkit Catalog

FREE! SEND TODAY!

HEATH COMPANY, Dept. 319-15
Benton Harbor, Mich. 49022

the Maxi Studio...

it gives you the quality you need, at a price you can afford.

The new Maxi Studio uses Revox 3500, Beyer M101, X1N and M500 microphones to accurately capture all types of sound even under difficult recording conditions.

The Lamb PML422 portable mixing system, which is infinitely expandable, brings big desk versatility, with such niceties as tracking limiters as well as full equalization together with stereo or quad panning and separate group outputs for treatment or foldback.

The Revox is simply the best 10½" reel capacity, three speed, portable tape recorder ever built – with performance specifications considerably in excess of broadcasting requirements.

Send for full details and address of your nearest stockist to: Lamb Laboratories, 155 Michael Drive, Syosset, New York, U.S.A. 11791 or Lamb House, Church Street, Chiswick, London, England W4 2PB.

the Maxi Studio - predictable professional performance.

THE LAST LOUDSPEAKER (REVIEWED).

When we introduced the Ohm F a few months ago, we called it the last loudspeaker.

We explained that this new invention (U. S. Patent 3,424,873) is the last loudspeaker in the same sense as the wheel was the last device for transmitting rotary or rolling motion.

Like the wheel, we said, our speaker is a mathematically perfect engineering concept, utterly simple and unimprovable. Only its physical construction can evolve further, not the design itself. When a single cone reproduces 30 to 20,000 Hz without crossovers and has a cylindrical output in perfect phase with the input signal at all frequencies ("coherent sound"), the design can be considered final.

Since then, our claims for the Ohm F have found support in the authoritative editorial pages of Stereo Review. In the November 1973 issue, the Equipment Test Reports by Hirsch-Houck Laboratories asserted:

"The Ohm F can do some things that no other speaker in our experience is capable of."

After acknowledging that "the cone has not been designed to function as a 'piston' (as virtually all other cones are), but should be viewed as a terminated acoustic transmission line," the review states that "the Ohm F produced one of the flattest extended curves we have ever seen ...it has a uniform energy output across the full audio-frequency range..."

Square-wave tests of the Ohm F against "several other fine speakers we had on hand," in the words of the review, showed that "only the Ohm F was able to produce a reasonable facsimile of a square wave." This plus the toneburst response of the speaker "tended to confirm . . . that it has transient-response capabilities surpassing those of the best conventional (piston) speakers."

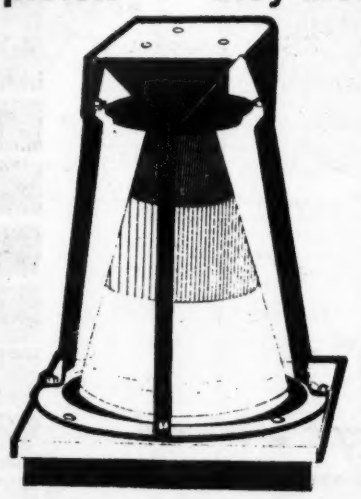
Further excerpts from the Ohm F test report:

"In our simulated live-vs.-recorded test it rated A to A+ . . . with one of the larger power amplifiers, able to deliver 100 watts or more, the sound began to warrant the use of such words as 'awesome' . . . achieves state-of-the-art performance."

The conclusion of the review requires some reading between the lines:

"As to whether or not the Ohm F is therefore the 'best' speaker available—we will leave that to the ears of audiophiles; we are prepared to say, however, without reservations, that it is easily one of the best."

Think about that. Wouldn't any responsible journal hesitate to declare categorically that a totally new and unfamiliar product is the best, period? Even if they thought so?



The Ohm F comes in a striking, tapered column cabinet, about 3½ feet high, and is priced at $500. If your local dealer doesn't carry it yet, write us and we'll help you.

We want your next loudspeaker to be the last loudspeaker.

Ohm Acoustics Corp.,
241 Taaffe Place,
Brooklyn, N.Y. 11205.

Ohm

We want you to know about Hy-Gain, the citizens two-way radio system that makes instant, two-way communications from your car as easy as using a telephone.

With a Hy-Gain system in your car you'll be aware of what's happening on the highway ahead. It can call help to a deserted stretch of road. Or give you friends to talk with on a long and tiring trip.

To find out more about this exciting form of high performance personal communications, drop this coupon in the mail today.

It will bring you complete information on the world of citizens two-way. And on the wide range of quality Hy-Gain Citizens Two-Way radios, antennas and accessories.

This includes valuable information on how you can use citizens two-way, how easy it is to get your license, what to look for in a radio, how to buy the radio/antenna system that's right for you, and much, much more.

Discover the world of Hy-Gain Citizens Two-Way, where you've always got a friend, near as your Hy-Gain radio.

MAIL TO: Hy-Gain Electronics Corporation; Box 28; Kensington Station; Brooklyn, NY 11218. BP 3/2

To receive information, you must include your zip code. Offer ends 6 weeks after date of issue.

☐ MR. ☐ MS. NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

hy-gain® You've got a friend.

Hy-Gain Electronics Corporation 8601 Northeast Highway Six; Lincoln, NE 68505
Hy-Gain de Puerto Rico, Inc. Box 68; Naguabo, PR 00718

Manufacturers and distributors of more than 300 fine broadcast communications products.

© 1975 Hy-Gain

ESS TAKES THE HEIL ROAD

Explaining the air-motion transformer

Dr. Oskar Heil

by John Schlafer

For the last three years ESS, a West Coast speaker manufacturer, has been exploiting a principle new to speaker design. They describe it with the imposing term "air-motion transformer." ESS used to specialize in hybrid speakers, an electrostatic top end mated to a cone woofer. Then one spring day in 1972 Phil Coelho, ESS's president, took a call from a fellow who wanted to buy one of their woofers to go with a new midrange-high frequency driver he had invented. Intrigued by the description of this device, Coelho arranged a demonstration in trade for the woofer. That demonstration proved to be an embarrassment to their top-of-the-line electrostatic tweeters, and ESS soon began negotiations for the rights to an idea which was to become the foundation of their business.

The man responsible for this development, Dr. Oskar Heil, may seem an unlikely candidate for inventing a new type of loudspeaker. He comes on as central casting's version of the archetypal German scientist, complete with Einsteinian shock of white hair, Teutonic speech, and an assured manner which leaves the feeling that it was all elementary. He has been inventing for most of his 68 years, though, and holds the original patents on the FET transistor and the microwave klystron tube. Educated as a physicist, he has worked in such exotic disciplines as molecular spectroscopy, nuclear physics and home-brew hi-fi gear.

It was in this last pursuit that he began to appreciate the limitations imposed on most traditional speaker designs by their inefficient coupling of electrical energy to sound energy. Of the power pumped into a loudspeaker by the amplifier, only about one percent or less actually ends up as sound. The rest is used in pushing and pulling the relatively heavy speaker cone or diaphragm through the large excursions needed to get the air moving. It was obvious to Heil that what was needed was a sort of air transformer which would convert small movements of the heavy speaker diaphragm into larger motion of the light air. These shorter excursions meant less energy would then go into accelerating the diaphram for the same amount of sound output.

Using an idea which he had conceived earlier for building a microphone sensitive enough to register the impact of the random motion of the air molecules, Heil developed the air motion transformer speaker. Where conventional speakers use a cone or dome to push the air, the Heil unit squeezes air out from between folds in a pleated diaphragm. Current from the amplifier flows in foil-like wires along the flat sides of the pleats, pushing them together as it reacts with the magnetic field and expelling air like a bellows. Because the velocity of the air squirting out the open end of the fold is greater than the velocity of the diaphragm, the device is touted as an air-motion transformer.

The Heil driver principle is being parlayed into a big business by ESS. First introduced in March of 1973, when ESS was grossing under one million, their speaker line has proliferated to some 16 models and income has expanded by 14 times. Heil stereophones are also now being introduced, and it is rumored that a Heil microphone is in the works.

Never satisfied with less than perfection, Oskar Heil has been developing the speaker further ever since it was put into production. One of his pet gripes is that he must use solid materials in the diaphragm to push on the

Continued on page 30

maxell®

30% OFF SALE

ITEM	REG. PRICE	SALE	ITEM	REG. PRICE	SALE
LN C-60	1.79	1.25	LN50-120	12.89	9.02
LN C-90	2.79	1.95	LN35-90	5.99	4.19
LN C-120	3.69	2.58	LN35-180	17.59	12.31
UDC-60	2.79	1.95	LN25-120	9.89	6.92
UDC-90	3.99	2.79	LN18-180	12.19	8.53
UDC-120	5.39	3.75	UD50-60	5.99	4.19
UDXL-C60	3.70	2.59	UD50-120	17.29	12.10
UDXL-C90	5.20	3.64	UD35-90	6.99	4.89
LN 8T-60	2.69	1.88	UD35-180	19.99	13.99
LN 8T-90	2.99	2.09	UD50-60B	7.69	5.38
UD 8T-90	3.99	2.79	UD50-120B	22.79	15.95
LN50-60	5.49	3.84	UD35-90B	9.09	6.36
			UD35-180B	25.79	18.05

ULTRA DYNAMIC UD

Back Coated Tape

UD XL

THIS SALE IS AN EXCLUSIVE TO PHOENIX READERS. YOU MUST PRESENT THIS COUPON TO GET 30% OFF ALL MAXELL TAPES.

SOME QUANITIES LIMITED. FIRST COME FIRST SERVED

DOORS OPEN AT 9:00 A.M.

Music Center

BETWEEN ARLINGTON & BRKLY

975 ELM ST.
MANCHESTER, N.H.
603-669-1067

"YOU'll LIKE WHAT YOU HEAR"

372 BOYLSTON ST.
BOSTON, MASS.
617-267-3708

Why any cartridge (even ours) with an elliptical stylus must be considered just a bit old-fashioned.

As a premium stylus, elliptical designs have only one real advantage over a Shibata stylus: lower cost. Which is why we still offer them.

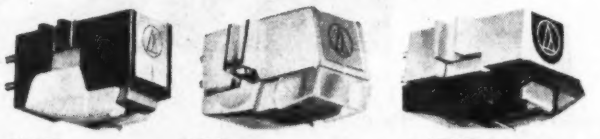
But when it comes to performance, a Shibata stylus is far, far better. It provides the small scanning radius needed to track highs (up to 45 kHz for CD-4), but without the penalty of requiring extremely low stylus force settings.

In fact, even when tracking at up to 2 grams, a Shibata stylus is easier on your records than an elliptical stylus trying to track at 1/2-gram! New records last longer, old records sound better, and you can play every kind of two or four-channel record made.

All Audio-Technica Universal Series cartridges have genuine Shibata styli. Anything less would be false economy for you...and out-dated technology for us.

Prove it to yourself today.

UNIVERSAL™
BEST FOR 1/2/4 CHANNEL



AT12S AT14Sa AT15Sa

AUDIO-TECHNICA U.S., INC., Dept. 36BP, 33 Shiawassee Ave., Fairlawn, Ohio 44313
Available in Canada from Superior Electronics, Inc.

audio-technica®
INNOVATION □ PRECISION □ INTEGRITY

From The Inventor Of Audio Tape

BASF BLANK TAPE SALE

BASF 60 PERFORMANCE SERIES
NOW $1.99
Reg. $2.49

BASF STUDIO SERIES
NOW $2.75
Reg. $3.19

BASF 60 CHROMIUM DIOXIDE
NOW $2.75
Reg. $3.19

the Coop

CHILDREN'S HOSPITAL MEDICAL CENTER
HARVARD SQ.
MIT STUDENT CENTER

the music tape™ BY CAPITOL

BUY 1 GET ONE AT 1/2 PRICE

SUPER QUALITY...SUPER DEAL

- Pick up one of these blank 90 minute 8 track cartridges now, at the regular price...get a second at half price!
- The Music Tape™ by Capitol® is high output/low noise formulation for virtually perfect recordings everytime.
- There's no limit while the supply lasts, so hurry in. Now!

$3.99

BUY 2... GET ONE FREE

Sound Gatherer...Music Giver.
90 Minute Recording Cassette

- Pick up two of these outstanding C-90 cassettes now, and get the third one FREE.
- Extra high output/low noise formulation.
- No limit per customer while the supply lasts...hurry in today!
- Also special Bonus offer on unique cassette storage system.

the Coop

$3.49

HARVARD SQUARE
M.I.T. STUDENT CENTER
CHILDREN'S HOSPITAL MEDICAL CENTER

HIRSCH

Continued from page 12

fend the audio purists, because they will always be able to pick holes, they'll always have some speaker which they think is the greatest (and we all do); but I was delighted, a while ago, to have a speaker which I felt was very undistinguished come my way, as I had forgotten that such things still exist.

BP: You wouldn't want to specify what speaker that was —

JH: Certainly not!

Platter Matters

BP: Have you come to any conviction yet on the importance or the unimportance of phase shift in the crossover region of loudspeakers?

JH: No, I've come to no conclusion at all. I've been following what is being written on the subject, the very interesting work that Bang & Olufsen have been doing on that, and I have not heard their speakers yet, so I'm curious; and I'm sure in time I'll have my chance to find out. I can only remember, though, that there have been any number of previous cases where a manufacturer has concluded that the deficiencies in a certain component are due to some effect. And he can prove this by measurements, by theory, by any way he chooses. Then he goes to some pains to correct this effect. And he proves again by theory and by measurements that he has corrected this effect. The new product is proudly hailed as being free of this distortion. And when I hear these "great developments" I am struck by the fact that the product sounds no better than any other.

Most of the panaceas that are being offered for our hi-fi problems are not really getting to the nub of it at all. The weak component in a hi-fi system is the recording. *The* weak, not the weakest one. Here I will over-simplify: I think that 95 percent of our departure from reality is right there in the recording. And most of the other five percent is in our speakers and in our environment. You can allot maybe .001 percent to your amplifiers and to other things which are so nearly perfect that they don't even figure into the deficiencies of a hi-fi system today.

We all know that there are speakers that, when certain recordings are played through them with certain other equipment, sound absolutely superb. They have the illusion of liveness that we're all after. And yet you could take that same speaker and take any record off your friendly dealer's shelves and play it, and it's just another speaker: big, loud and expensive. So it's not the speaker that's the answer, in my opinion. Because you can take that recording that sounded great, and you could play it through any of a dozen other speakers and it would still sound great.

BP: Many of us who are longtime readers of *Stereo Review* have felt that the magazine's principal weakness is that it hasn't tried to wage a consumerist campaign in favor of better recordings. One doesn't often read in a record review that "the British pressing of this recording is vastly superior to the American one, so don't bother with the American." Or that "this recording has a five-eighths of an inch warp on it, making it unplayable, so don't bother." People don't get told things like that, and they ought to be.

JH: I can't speak for the record reviewers. I know that many of them are more concerned with the musical values than the sound values, which is perhaps right, and I don't blame them for their decisions. But I don't understand to any greater extent than that why they don't strike out for better record quality. I am not a heavy record collector, and I've heard enough of some of the better imported pressings to know that they are superb, and that there's almost nothing made over here which is comparable, which is why I made the statement earlier about the recording itself being the big millstone around our high-fidelity neck.

BP: To what extent was this feeling responsible for the special treatment you gave last year in reviewing the Advent pre-recorded cassettes?

JH: I had received the cassettes *not* necessarily for review, and I enjoyed them, listened to them, said how great I thought they were, and I thought that was the end of it. Then, some months later, *Stereo Review* asked me if I would write a technical review. So I listened to every one of them with a very critical ear, to provide a backup for the musical judgments of the music reviewers. Those cassettes were so good that it was obvious to me — and one or two of them I have on record, because they were made from the same masters — that the cassettes are better than any of the domestic records I have. And this is a very interesting thing, of course, because they don't have the purported frequency range of a record, and they have all the other vices that we know cassettes have. They sounded just great. I don't understand why more people don't do it, except I suspect Advent is not making money hand over fist on these things. But more power to them.

Quadriplegic?

BP: Four-channel systems have been strikingly absent from your product reviews. There are fundamental advances (in the sense of being in an environment with the musicians) that can be achieved with four, six or eight channels which cannot be achieved with two channels. How important an advance do you think that is, either potentially or actually?

JH: First of all, what we review in *Stereo Review* is largely the decision of the manufacturer — in other words, what he wants to have reviewed. So you can judge for yourself how much four-channel hardware equipment there's been lately — there's been nothing. I haven't seen four-channel equipment is some time. Even if a manufacturer still has it in his line, when he's asked, "What do you have that you'd like us to cover?" he sends along a turntable or a cassette deck or a two-channel receiver. So much for that.

Secondly, I was a very early convert to four channels as a medium; the potential of it was tremendous. I still believe in it. However, to get back to the beginning of your question, I don't think the subjective realism of a recording has much to do with how many channels are on it, and that includes mono. That's a heretical statement to make, but I only make it because not too long ago, when I was evaluating on a subjective basis the Phase Linear Autocorrelation system, I made a point of listening to a lot of my old records. You probably remember some of the early Mercury Olympian series. Strictly mono. They were impressive then, but they're noisy. And they had tracking problems on the pickups in those days. I dragged out some of those, which were in pristine condition because they hadn't been played since about 1955, and I played them through the best of modern pickups, through some of the best modern speakers, through a few hundred watts of the best modern amplifiers, and with noise-reducing equipment to take care of that terrible noise, and with a little rear-channel synthesis, and the result was absolutely mind-boggling. I sat there and listened to these records and I had this sense of "liveness" that I get out of maybe one out of a hundred modern stereo records. And at that time I realized that there's something, some magic ingredient that is missing in too many records today, and it's got nothing to do with whether they have one, two or four channels. It isn't only reverb, although I'm sure that's some of it, because those recordings were made in as nearly natural an environment as possible with a single microphone. I'm not a recording expert — whatever techniques they used, they worked. There is literally nothing that I've come across in recent years that sounds as good when heard properly.

BP: Do you listen routinely with a pair of ambience-recovery speakers in the back of the room?

JH: I like having the ambience speakers on in the back. The only problem is, the way my room is oriented, I'm sitting back near those speakers. It's a bad listening spot. I have to turn their level down to keep them from drowning out the front speakers.

BP: The cure to that problem will be to delay the signal to the back speakers by 30 milliseconds, and then you won't hear them.

JH: A year ago last summer I heard a demonstration of that at the AKG plant in Vienna, where they used digital time-delay, and their reverb units, and they synthesized the back channels out of stereo. Those of us who were there agreed that that was some of the best "quad" we had ever heard.

Testing—1, 2, 3 . . .

BP: On the average, how long does it take to do a complete preparation of a product review?

JH: It's very difficult to give a straight answer to that, because I don't sit down and say, "Well, now I'm going to review a model blah amplifier," and then take it out of the box, set it up, test it — I just don't do it that way. The product arrives — I'm like a kid coming down Christmas morning to the Christmas tree when something shows up. Larry Klein kids me a lot about still having that enthusiasm, but I do have it. Some box is delivered and, say, it's a new receiver. Well, the first thing I'll do, after typing up a folder for it and entering it in my log of projects, is I'll find a way to set it up. And I'll use it normally for days, for weeks, sometimes even for months before I'll ever put an instrument to it. During those few weeks, if that product is going to blow up, it will. If it's out of calibration, or if it does something peculiar, I'll find it out then, and I won't

Speaker Kits.

There's one part of your component system you never thought could be assembled as a kit. Money-saving, multi-element stereo speakers. Build them yourself to save up to half the retail cost of comparable ready-built systems. And get great sound in the bargain.

Send us the following coupon to get your free 32-page catalog of speaker kits, raw speakers, crossovers, enclosures and tips on design and construction. It's practically a manual on speaker building.

BP1

NAME

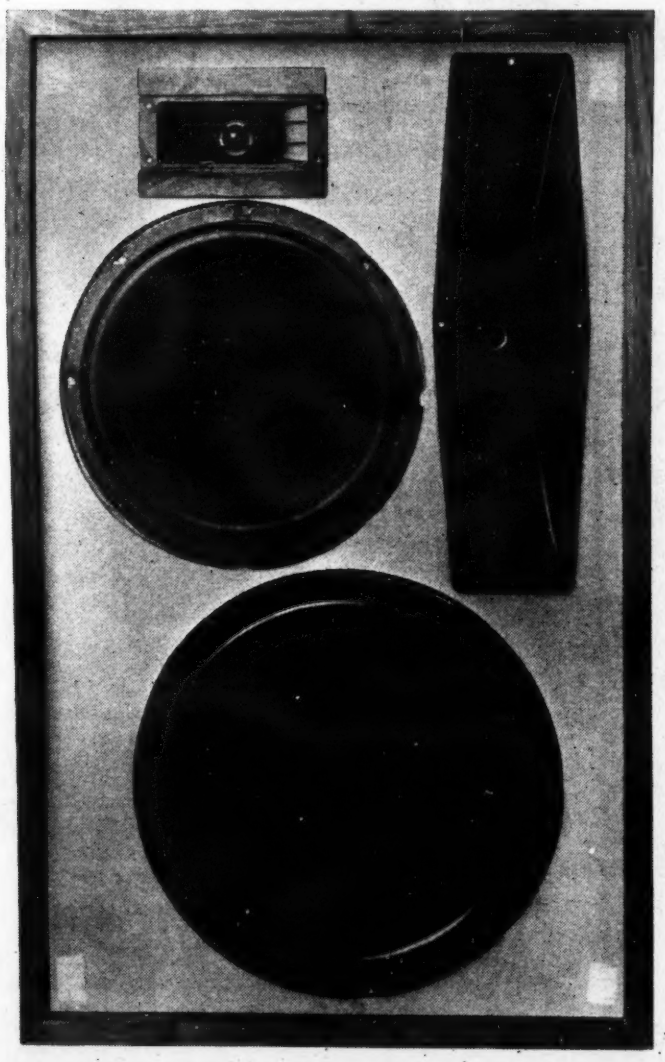
ADDRESS

CITY STATE ZIP

MAIL TO:

Speakerlab

Dept. BP1 5500 35th N.E., Seattle, Wa. 98105



© 1975

waste my time on the bench with it.

Then I get the notification from my publishers of what products will be in what issue. And as the time approaches, I'll test it. Testing is the easiest part. It may take anything from a couple of hours to a day, and that's it. Then the writing up — I write very fast, so that's just another two or three hours' work. But it's always done while the product is in use. I'm a lousy typist, and I have to take a break from the typewriter. I go over and make sure that what I'm writing is what happens with the system. . . . So, it's a process of living with the thing. While the actual work, from unpacking to setting up to testing to writing and typing it up again, probably doesn't average more than a day or two per product, the elapsed time is liable to be a couple of months.

BP: You mentioned earlier that manufacturers choose which product of theirs you will review. It's easy to suppose that manufacturers will very carefully take the product into their own test lab and give it a process of quality-control and careful tuning that they don't give to the thousands of products that they are shipping out to the dealers, so that in a sense you will get a product which is unrepresentative of what the consumer will buy. Why don't you just go out to a store and buy the product, instead of accepting what the manufacturer sends you?

JH: I'm glad you asked me that. I used to do that at one earlier stage in my career, and it was fine, except it's very time-consuming. Where I live, there aren't any handy stores. Secondly, I wish the manufacturer *would* check out the product before we get it. You don't know how frustrating it is — I just went through this recently with a tape recorder, a fairly bulky, heavy thing, open reel machine. When a manufacturer is contacted by *Stereo Review* to submit equipment for review, we send them a form, which tells them where to send it, what information to provide, and we ask them specifically to take the unit that is going to be tested and make sure that it meets all of their own standards, to provide us with test data on that unit so that we can cross-check it with ours to see if there are any differences. If it's a tape recorder, not only do we want to know what kind of tape it is set up for, but we want them to supply us with the actual tape that they used to make their measurements on, because that will differ from reel to reel. We want every bit of information we can get that will let us know when the thing is not working up to snuff. Well, I hate to tell you what a small percentage of manufacturers follow through on this. As a result, I'll get a product like this tape recorder with no clue as to what tape it was set up for. I spent a day running off a stack of curves about an inch thick, and concluded that this machine was just not set up right for any tape. So I've aborted a day's work, plus all the handling; the machine will have to go back, I'll have to get another one, and we'll start all over again.

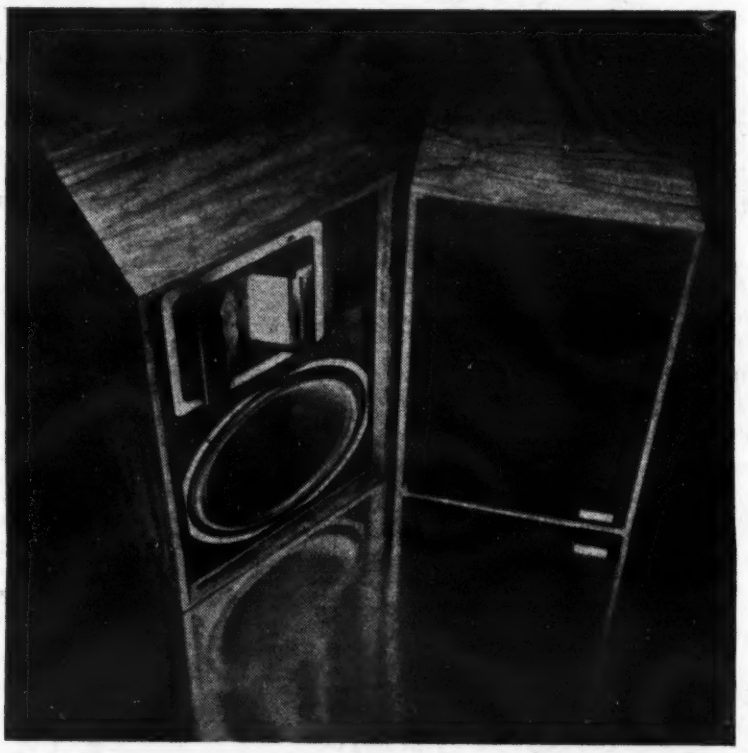
Incidentally, I'm not identifying this machine, and if the report appears in print, there'll be no mention of the problem — the manufacturer makes a certain number of products, usually hundreds or thousands. They will vary to some degree from one unit to another. If I were to pick one out of a store, if it did work, it wouldn't prove one thing about all the others in the store. If it didn't work, that also wouldn't prove one thing about all the others in the store. I'd just have to take another one and try it again. Instead of bothering the store, I'm going through the manufacturer and I'm asking him to give his product a fair shake by making sure that it works as well as he thinks it can work. I don't believe that limited sampling of one or two or three products tells you anything at all. But if I get two products that are *both* bad, I draw the line right then and there. Deep down inside me, I'd love to be able to print a back page in the magazine and say, "This and this and this were dogs." We don't do that. We leave that to others.

A question has been raised — suppose he's doctoring something up better than it could be? Well, if you know anything about the engineering involved in the electronic products, there's no practical way that they could doctor those things up. In almost all cases they come from Japan, sealed up in boxes; the best you can do is make sure they're in one piece and working up to snuff. You can't change the circuitry — you can't go through selecting values — they would do that in Japan if they knew how, if that would benefit them. So it's just not practical. With a phono-cartridge, they could doctor it up. A big company doesn't. A small company might. But that's the chance we take. With loudspeakers, we're dealing with a "black box," finished in walnut-colored vinyl. Therefore, he could put anything inside that box, and I don't know what the characteristics of the drivers are. Occasionally it has been suggested that maybe this or that manufacturer has slipped me a ringer in a loudspeaker system. When this is hinted at, we go out and we grab another one from a dealer, to make sure we weren't tricked. We have not been, as far as we know. Same thing happened with a cartridge. We thought a cartridge was much better than it had any right to be. It came from the manufacturer personally. So we went out and we bought a dozen more and checked them all and they all matched the first one. We sweated a little until we were able to do this because the report was in print already and nobody believed it. But we were convinced after that.

BP: Do you take things apart to see how they're constructed, to get a feeling for how easily serviced they would be, or just to get a feeling for the quality of construction?

JH: Yes, I generally do. If there is a visible means of disassembly, I take advantage of it. With some components I can't do that. There are some tape machines that to this day I can't figure how they put the case on, much less how they take it off. Of course, with speakers, short of prying off the grille, that's the end of it. I can look at the pretty color on the edge, but I can't judge a speaker from looking at it.

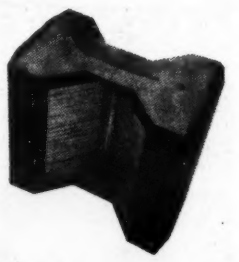
I do look for serviceability, but only in a gross sense, because most of the servicing will be done by the manufacturer's authorized service, and supposedly they know how to take it apart and deal with it, but I have seen some products which are magnificent. You open them up and everything is laid out like a book. And I say that if someone put in the effort to do the job right, then they probably did a lot of other things right. I won't deny that this will dispose me favorably — and usually the measurements will back up my impression. Quality shows all the way through. It's a cliche to say you get what you pay for, because you may pay one heck of a lot more for very little more, but that's a fact of life: you do, more or less, get what you pay for.



YOU DON'T NEED TO BE A PHYSICIST TO APPRECIATE THE DIFFERENCE

The difference between the amt-1a bookshelf speaker system and all the others.
Take off the grille. You can *see* the difference.
Listen to it. You can *hear* the difference.
The difference is the Heil Air-Motion Transformer.

All other speakers merely push air. The Heil Air-Motion Transformer actually *accelerates* air by squeezing it: effecting the most efficient transfer of an electrical signal to air motion of any device known.
Result: superior sound reproduction.



When you look for speakers, trust your ears as well as your eyes. Compare our new Heil Air-Motion Transformer system to any conventional speaker.

YOUR EARS WILL APPRECIATE THE DIFFERENCE.

Call toll free for the ESS dealer nearest you **(800) 447-4700**
In Illinois call (800) 322-4400

Sound as clear as light.
P.O. Box 26266 • Sacramento, California 95827

ESS

Continued from page 26

air, and these inevitably have mechanical resonances that color the sound. An approach which he has been pursuing to reduce this problem is to find a diaphragm material with a high internal mechanical loss that will tend to damp these resonances, occurring mainly in the diaphragm folds. In this respect, polyethylene has been one of the better materials used in diaphragm fabrication. Special coatings have also been employed to enhance damping. In applications where high acoustic powers must be generated, however, polyethylene literally cannot take the heat.

Heil found an improvement in power-handling capacity could be obtained, while maintaining good damping properties, by using a diaphragm of specially prepared FEP film, a teflon-like material, formed in such a way as to maximize its internal loss mechanisms without compromising mechanical strength. An added bonus is that the resonance can be made to occur at about 9.5 kHz, instead of at 5.5 kHz as in the old diaphragms, pushing the distortion-producing harmonics nearly out of the audible range. Harmonic distortion with the FEP diaphragm is now typically less than one percent. This material has been used with a new high-flux magnet structure to create a driver that will generate a 104-dB sound pressure level at one meter with one watt input over a 1.5-24-kHz frequency range. Capable of taking a continuous 35-watt sine wave input, this unit is destined for a new line of ESS sound-reinforcement speakers.

It is generally conceded that the Heil high-frequency driver has not yet been mated with a woofer which matches its efficiency and transient response. Oskar Heil had early conceived of a low frequency companion to the tweeter, but its perfection proved more elusive than expected. Two years and many models later it is finally nearing production. Its present form maintains the essence of the original geometry while incorporating newly developed materials and manufacturing technology to improve stiffness and reduce mass in the dynamic elements.

ESS plows about four percent of its income back into R&D. Part of this supports in-house work and part is used to sponsor outside individuals with promising ideas. One research project now well along is a tonearm-cartridge system in which unwanted arm motions are dynamically controlled.

The system starts with a tonearm that will maintain the cartridge tangent to the record groove as does the Garrard Zero-100, but with an entirely different mechanical configuration. The ESS design is based on the use of metal bands and cylindrical rolling elements that function both as bearings and for maintaining parallel alignment. One of the main problems yet to be solved before this arm can become commercially practical is finding a technique for producing the rolling elements that will not require costly precision-machining to maintain low rolling friction.

To the arm is added a cartridge capable of responding to very low frequency or to steady deflections of the stylus. Such a cartridge is also under development using strain-gauge elements to sense stylus motion. In addition to reproducing music, the cartridge would provide electrical signals corresponding to sub-audible or steady displacements of the stylus due to warps, cartridge-arm resonances and tracking-force variations. The signals due to these effects will be fed back to small torque motors, acting on the arm at its pivot, to dampen or cancel undesired low-frequency stylus displacements and to control arm tracking motion. This should be, according to its designers, a tonearm with power steering.

CB

Continued from page 23

the FCC has authorized unrestricted use of 21 of the 23 channels. (Channel 9 is still reserved for emergency distress-call use, and according to a new regulation channel 11 is supposed to be reserved for calling; after you establish contact with someone you are supposed to agree on another channel and move to it.) Channels 19 and 10 are both widely used by truckers for highway information.

This year 23-channel transceivers will be available for prices ranging from about $80 to $200. Obviously at the low end of the price range you get a unit with just the essentials, while higher-priced models have more features and may benefit from newer technology in the design.

The principal area of technological innovation in CB has to do with how the frequencies for the transmitter and receiver circuits are controlled. Older CB transceivers required 46 crystals for the 23 channels; the set was sold without crystals and you bought as accessories the crystals for the channels which you actually wanted to use. Most current sets contain 14 crystals and a "frequency-synthesizer" circuit which produces the 46 frequencies required to handle the 23 channels. Some of the higher-priced transceivers use a technique that will become increasingly common during 1976 and '77 — just three (or even one) crystals and a "phase-locked loop" or PLL circuit to produce all of the frequencies. The PLL has two advantages: it produces slightly more accurate frequencies, and it provides the manufacturer with the ability to expand to 50 channels or more, when and if the FCC authorizes the added channels. Furthermore, PLL units will remain relatively independent of the supply of crystals, which may run short as CB booms. Hy-Gain, SBE, Palomar, GE, Sharp, and Pace are among the brands that include at least one PLL transceiver in their lines.

Some of the features in higher-priced CB transceivers are as follows: a "delta-tune" or "clarifier" control, permitting you to tune slightly off-frequency to compensate for slight frequency errors in the transmitter or receiver; an S/RF meter, displaying signal strength of received signals and your transmitter output when broadcasting; switchable ANL, a noise limiter; and "single-sideband" or SSB, which raises your transmitter's effective power and range while making the transmitted sound somewhat garbled except to listeners with SSB receivers.

Pick-A-Pickering

It's the least expensive way to make the greatest improvement in the sound of your system

Here it is. The easy and inexpensive way to upgrade the sound of your entire hi fi system. Simply add a Pickering cartridge. Know why a good cartridge will make such a difference in sound? Because the cartridge and stylus have *first contact* with the music on your record. It's your *cartridge* that picks up the highest highs and the lowest lows in your record grooves. Not by plodding along, round and round, but by performing an incredibly quick dance between the two small groove walls. Too quickly for your eye to see, but not for your ear to hear. **No matter how much you sink into the rest of your equipment, a poor quality cartridge can murder the sound — bend the record grooves out of shape and blur the music.**

But not Pickering cartridges. They have a feathery touch we call TraceAbility™. A touch that lightly covers the whole range of musical tones on your record — giving you the type of sound you want to hear.

Upgrade your entire hi fi system the easy way, the inexpensive way. Just pick a Pickering cartridge, and you'll hear the difference.

For further information write to Pickering & Co., Inc. Dept. SR, 101 Sunnyside Blvd., Plainview, New York 11803

PICKERING

"for those who can hear the difference"

Lafayette Radio
All Stores

Lechmere Sales
All Stores

Olde Colony Stereo
Quincy
Hanover

K&L Sound
Watertown

Hi-Fidelity House
Worcester

TWO BIG NAMES IN STEREO

design acoustics incorporated — for quality

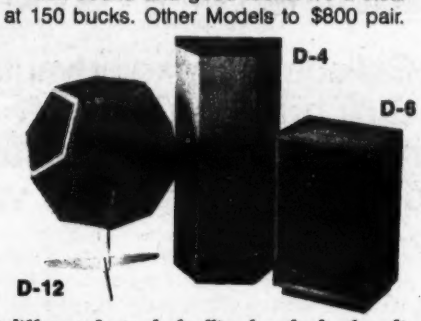
ARKAY — for price

Face the facts: superior sound, better price.

The D-2 from Design Acoustics. A new member in a line of highly acclaimed loudspeakers destined to perpetuate the tradition of superior performance established by the D-4, D-6 and D-12.

The D-2 is a two-way, wide-dispersion, floor standing system that you've got to hear to believe. And, it's all wrapped up in a stretched fabric grille and capped with rich walnut veneers.

Rich sound and good looks. It's a steal at 150 bucks. Other Models to $800 pair.



The way we do business is somewhat different. Instead of selling hundreds of mediocre brands, we carry only about 40 selected brands which we have found to have the most natural sound and the greatest reliability. We purchase these top rated components in large quantities and then sell them at the lowest possible prices.

Also, since we are the FACTORY WARRANTY STATION for most of these brands, you are assured if necessary, of fast, professional and competent repair service.

ARKAY AUDIO

"THE AUDIO PRO SHOP"

68 Watertown St. (Rt. 16)
Off Watertown Square
Free Parking • 924-1067

Only Minutes from Boston & Cambridge • Plenty Of FREE Parking

Listen to our Best Buy, Check Rated,

Stereo Super Velocity Headphones

Model HP-50

Super velocity, super thin, super sensational—it's the all new Thin Line, by Royal Sound. The powerful magnet in the drive unit allows the thinnest, lightest headphone configuration ever shown. Composite earpads, super thin polyester film drive unit diaphragm combine to produce a sound that's as lively and true as the original performance. Smart, heavy duty, long lasting black simulated leather headband is a natural frame for this feather light set.

Model HP-50 Data:

- ☐ Sensitivity: 100 dB SL/mW
- ☐ Frequency range: 18-22,000 Hz
- ☐ Matching impedance: 4-150 ohms each channel
- ☐ Maximum input: 0.1W
- ☐ Weight: 130 gr. (4 oz.)
- ☐ Cord: 10 ft. straight with stereo plug

Royal Sound Company, Inc. 409 North Main St., Freeport, N.Y. 11520

Hear the Super Velocity Headphones At:

Tech HiFi
2 Teed Drive
Randolph, Mass.

165 Angell Street
Providence, R.I.

1989 Post Road Route 1
Warwick, R.I.

280 Worcester Road
Framingham, Mass.

870 Commonwealth Ave.
Boston, Mass.

850 Providence Highway
Dedham, Mass.

279 Main Street
Worcester Mass.

38 Boylston Street
Cambridge, Mass.

352 Main Street
Stoneham, Mass.

Nashua Mall
Nashua N.H.

182 Mass. Ave.
Cambridge, Mass.

240 A Newbury Street
Boston, Mass.

Waltham Camera
367 Moody Street
Waltham, Mass.

Minuteman Radio
28 Boylston Street
Cambridge, Mass.

Lechmere Sales
88 First Street
Cambridge, Mass.

688 Providence Highway
Dedham, Mass.

Boston Post Road
Springfield, Mass.

Liberty Tree Mall
Danvers, Mass. 01923

Radio Shack
Main Street
Marlboro, Mass.

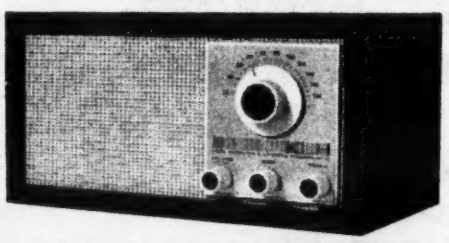
Resistor-Tronics
Burlington, Mass.

For Those of You Who Like It Straight and Simple. . .

The Model Twenty-One CL

The KLH Model Twenty-One CL is a serious high fidelity radio for serious music listeners who also want to know what time it is. Accurate digital clock with alarm & wake-up features, not to mention AM/FM tuning with uncanny sound.

The Model Twenty-One FM



The KLH Model Twenty-One FM is much more than meets the ear. Besides being a self-contained radio, it has outlets for external speakers and for making tape recordings. It's just the best FM radio you ever heard.

BRIGGS & BRIGGS, INC.

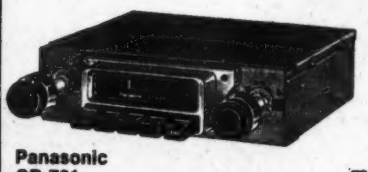
ESTABLISHED 1890
1270 MASSACHUSETTS AVENUE
Harvard Square
CAMBRIDGE, MASSACHUSETTS 02138
617-547-2007
OPEN DAILY 9-6

master charge — BANKAMERICARD

AUTO STEREO SPECIALISTS!!

Panasonic — Craig — Pioneer — Clarion — Muntz
I.D.I. — J.I.L. — Lear Jet — Many More

Special Purchase of Panasonic "In-Dash" Stereo Radios!



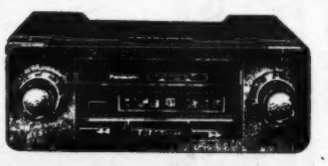
Panasonic
CR-701
FM/AM/FM STEREO CAR RADIO

All Panasonic Auto Products have a limited warranty of one year on parts and labor thru Authorized service centers

For Most Domestic Cars, Trucks and Vans

Model CR701 Special Price	109.95
2-matching Panasonic Spkrs.	15.00
	$124.95
Installation	25.00
Total Package Plus Tax	**$149.95**

PLEASE NOTE: These Radios were designed for use in 1975 G.M. and Ford Vehicles. The appearances have been modified for custom installation into virtually any domestic car, truck or van. With the purchase of any additional "Installation kit, it may be custom installed into many imported vehicles. Package does not include FM Antenna



Panasonic
CQ-742
IN-DASH STEREO CASSETTE PLAYER WITH FM/AM/FM STEREO RADIO AND AUTO REVERSE/LOCK-IN FAST

Forward/Rewind
Limited Information **$209.95**

Panasonic
CX-141
CAR STEREO CASSETTE PLAYER WITH AUTOMATIC REVERSE/LOCK-IN FAST

Forward/Rewind Under Dash **$119.95**

Professional Installation Available At Moderate Prices
In Store Warranty On Every Thing We Sell

Our professional installation is guaranteed the original user in whose vehicle we installed the system for as long as that person owns the vehicle.

THE STEREO PLACE

277 Worcester Rd. (Rte. 9) Framingham
Exit 13 Mass. Pike — 30 Minutes From Boston
Tel: 873-9171 • 879-1352
Hours: 9-9 Daily, Sat. till 6:00 P.M.

BRANDS MART

DISTRIBUTION CENTER

127 Smith Place (near Fresh Pond) Cambridge • 547-6900

HOURS: Mon. & WED. 9-9 • TUES., THURS., AND FRI., 9-6 SAT. 9-4

We're off Concord Ave., between Fresh Pond Shopping Center and Sancta Maria Hospital, easily accessible by the Concord Avenue Bus out of Harvard Square

1) Not open to dealers. 2) One coupon ner customer. 3) One coupon per item. 4) Expiration dates strictly adhered to. 5) Not responsible for typographical errors.

Other Brands Mart Locations: 41-50 22nd St., Long Island City, N.Y. 915 Grand Ave. New Haven, Ct. 120 E. Industrial Court, Deer Park, N.Y.

If you have a **BRANDS MART Card** or College I.D. take advantage of the extra savings being offered right here. Just bring your CARD and you'll save on major appliances, bedding, furniture, carpeting, eyeglasses, jewelry, TV's, kitchen cabinets, air-conditioning, and bathroom vanities, as well as audio components.

At BRANDS MART, You Don't Get Clipped; You Do The Clipping

System offers require no coupon.

Coupon No. 644

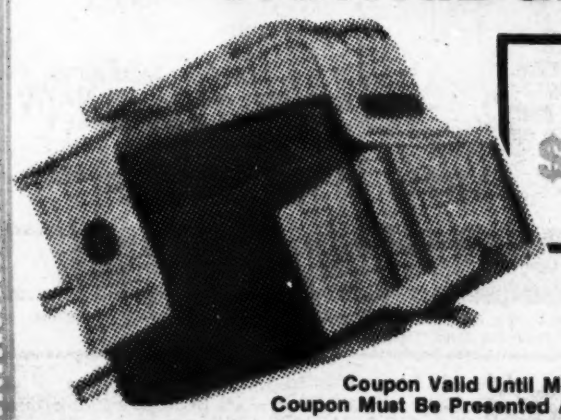
KOSS PRO 4AA STEREOPHONES

Coupon Price **$31.31**

Coupon Valid Until March 13, 1976
Coupon Must Be Presented At Time Of Purchase

Coupon No. 645

SHURE M91ED ELLIPTICAL MAGNETIC CARTRIDGE



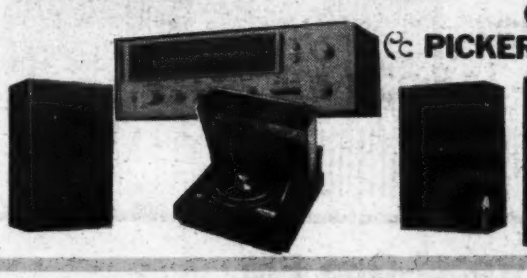
Coupon Price **$14.99**

Coupon Valid Until March 13, 1976
Coupon Must Be Presented At Time Of Purchase

Sherwood S7010 AM/FM STEREO RECEIVER
2 MT BOOK 1 LOUDSPEAKER SYSTEMS
BSR 2260BX Automatic Turntable
Complete with ADC CARTRIDGE

Unbelievable Low Price **$193**

Sansui 221 AM/FM STEREO RECEIVER
2 Studiocraft By BOSE 220 LOUDSPEAKER SYSTEMS
Garrard 440M Automatic Turntable
Complete with PICKERING CARTRIDGE



Unbelievable Low Price **$293**

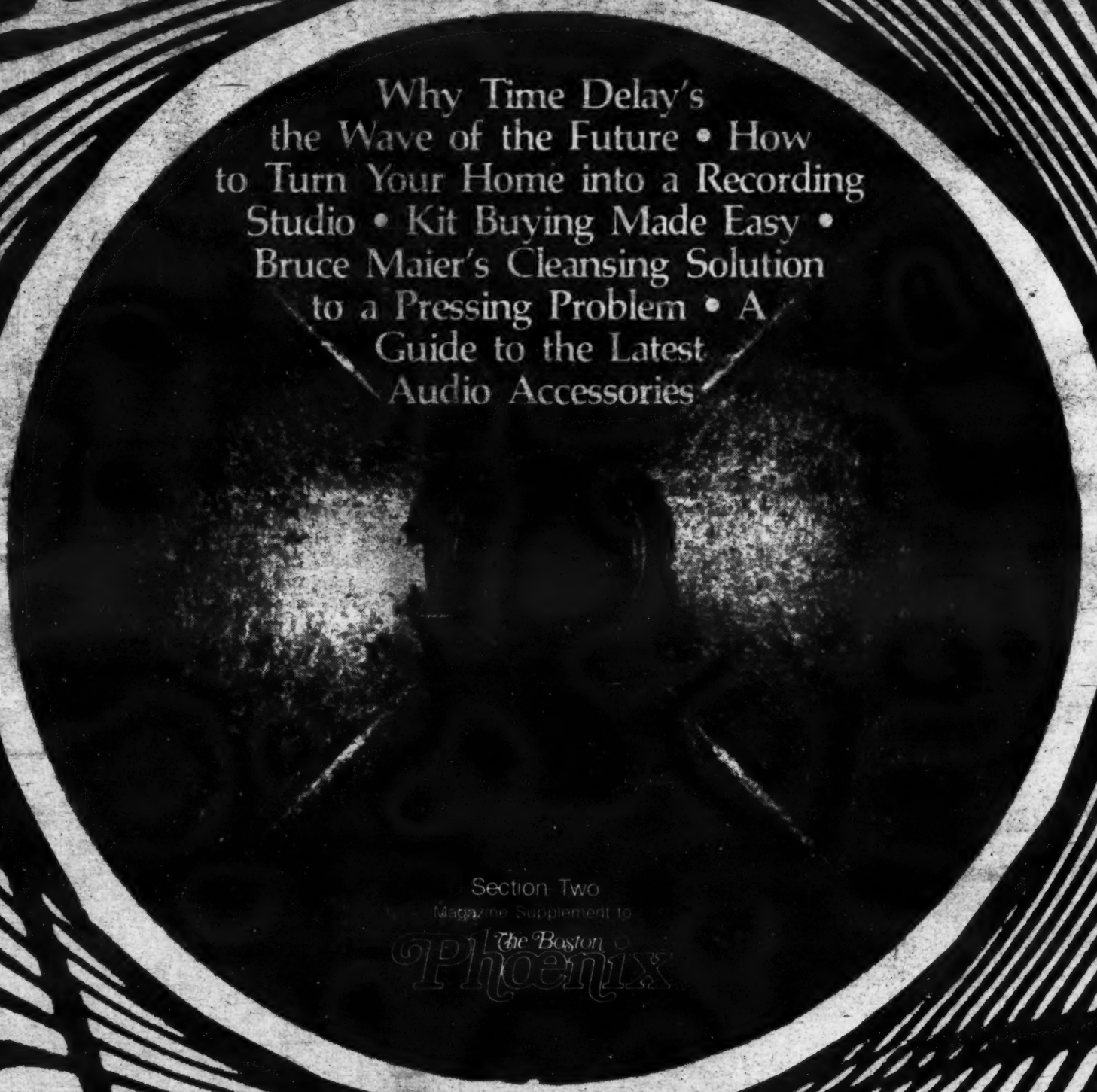
Technics by Panasonic SA 5150 AM/FM STEREO RECEIVER
2 BOSE 301 LOUDSPEAKER SYSTEMS
BSR 2320W Automatic Turntable
Complete with ADC CARTRIDGE

Unbelievable Low Price **$393**

SEE OUR FULL PAGE AD IN THE OTHER PHOENIX HI-FI SUPPLEMENT SECTION FOR MORE SPECIALS

SOUND ADVICE

Why Time Delay's the Wave of the Future • How to Turn Your Home into a Recording Studio • Kit Buying Made Easy • Bruce Maier's Cleansing Solution to a Pressing Problem • A Guide to the Latest Audio Accessories



Section Two
Magazine Supplement to
The Boston Phoenix

TANDBERG

10XD bridges the gap between consumer and professional tape recorders.

Meet the world's first and only 10½" reel tape recorder that operates at 15 ips and combines Tandberg's unique Cross-Field recording technique with the world-famous Dolby* B system. Result: A *guaranteed minimum* signal-to-noise ratio of 72 dB, measured on a 4-track machine using IEC A-weighting. Simply put, the 10XD completely eliminates audible tape hiss!

Here are some of the many sophisticated features that make the 10XD the finest tape recorder Tandberg has ever built:

- 3 speeds: 15, 7½, 3¾ ips. Electronically selected
- 3 motors: Hall-effect capstan motor
- 3 heads: plus separate bias head
- Electronic servo speed control
- Electronic logic mode controls including photo optics
- Electronic balanced microphone inputs
- Echo, sound-on-sound, editing, A and B tests
- Peak reading meters
- Direct transfer from playback to record (flying start)
- Ferrite playback head with symmetrical balanced output for hum cancelling purposes and differential playback amplifier

Remote control and rack mount optional. Pitch control by special order. For a complete demonstration of this remarkable new advance in stereo tape recording, see your Tandberg dealer.

*Dolby is a trademark of Dolby Laboratories, Inc.

Tandberg of America, Inc., Labriola Court, Armonk, N.Y. 10504
A. Allen Pringle Ltd., Ontario, Canada

See any of these Tandberg dealers in your area

MASSACHUSETTS

Music Box
38 Central Street
Wellesley

Nantucket Sound
Cape Cod Mall
Hyannis

Nantucket Sound
North Dartmouth Mall
North Dartmouth

Nantucket Sound
Swansea Mall
Swansea

Stereo Shops
80 Langley Road
Newton Center

Suffolk Audio
1105 Massachusetts Avenue
Cambridge

Tech Hi Fi
240A Newbury Street
Boston

Tech Hi Fi
38 Boylston Street
Cambridge

Tech Hi Fi
580 Providence Highway
Dedham

Tech Hi Fi
280 Worcester Highway
Framingham

Tech Hi Fi
352 Main Street
Stoneham

Tech Hi Fi
677 Main Street
Waltham

Tech Hi Fi
279 Main Street
Worcester

Tech Hi Fi
870 Commonwealth Avenue
Brookline

Tech Hi Fi
182 Massachusetts Avenue
Cambridge

Tweeter Etc.
163 Amory Street
Brookline

Tweeter Etc.
874 Commonwealth Avenue
Brookline

Tweeter Etc.
849 Belmont Street
Brockton

Tweeter Etc.
102 Mount Auburn Street
Cambridge

Tweeter Etc.
Chestnut Hill Mall
Newton

NEW HAMPSHIRE

Manchester Music
62 Lowell Street
Manchester

Sound Smith
242 State Street
Portsmouth

Tech Hi Fi
35 South Main Street
Hanover

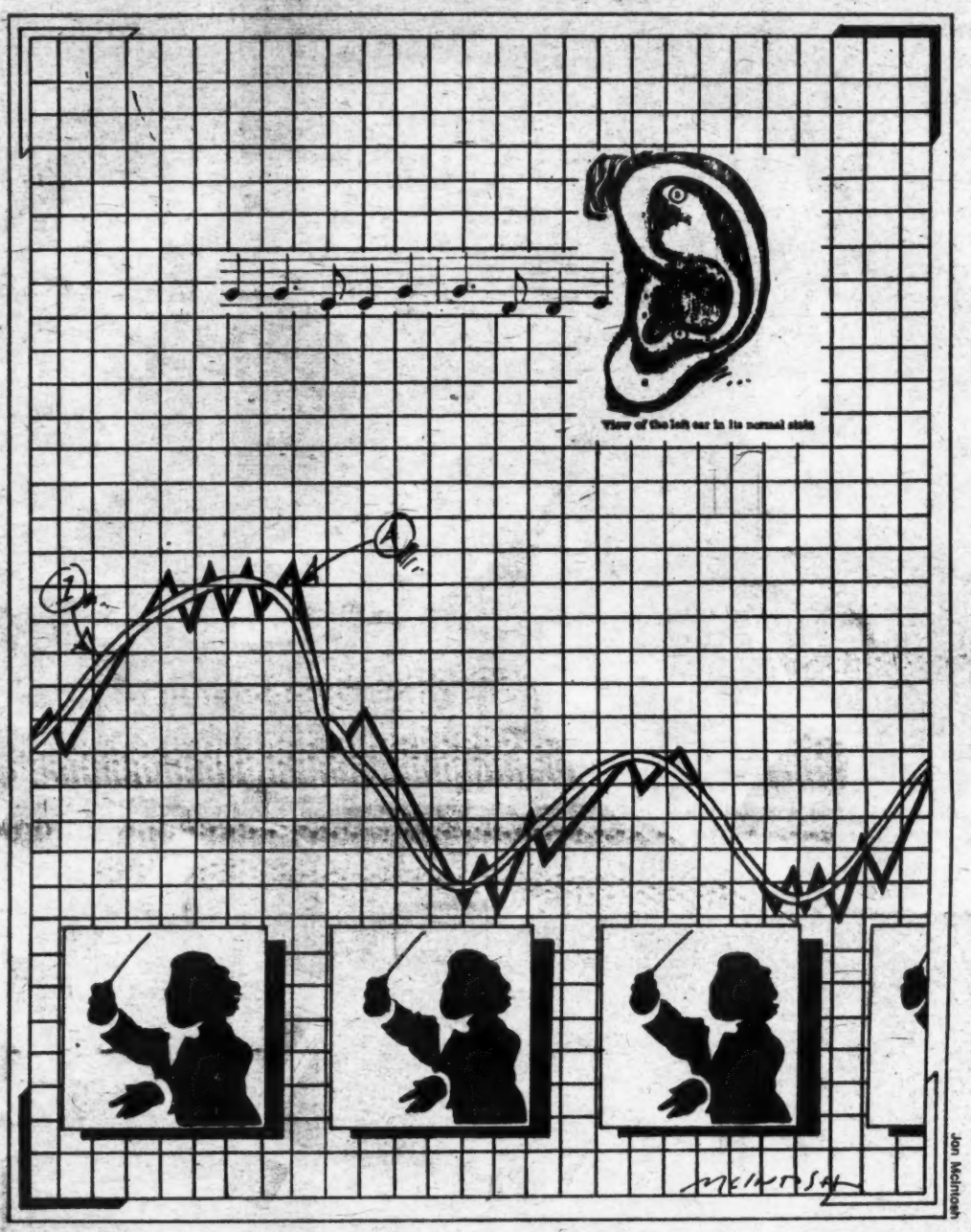
Tech Hi Fi
249 Nashua Mall Extension
Nashua

RHODE ISLAND

Sound-O-Rama
758 Reservoir
Cranston

WE HAVE SEEN THE FUTURE

And it is time delay



by Michael Riggs

Nearly everyone who owns a stereo system (no matter how elaborate) will admit, manufacturers' claims of "concert hall realism" notwithstanding, that it doesn't sound like the real thing. There are many reasons for that, but one in particular stands out. An ordinary stereo system simply cannot recreate the spatial characteristics of a live performance.

The hi-fi industry has heard, and tried to correct, this failing. Loudspeakers that bounce most of their output off rear and adjacent walls came into vogue for awhile. Their main achievement was a somewhat more diffuse and spacious sound than could be created by ordinary, front-firing speakers, but usually at the sacrifice of some focus and detail. And they didn't make anyone's living room sound like Symphony Hall.

The most recent attempted solution was four-channel, or quadriphonic, sound. Here at last was a method that offered some reasonable hope of success, by providing two additional channels devoted to the reproduction of the reverberant field of the space in which the recording was made. The reverberant field is that region in which most of the sound reaching the listener comes from reflections off the walls of the auditorium rather than directly from the stage. The sound that travels directly to the listener's ear tells where the musicians are; the sound from the reverberant field tells what kind of space surrounds the listener.

The reverberant field makes two other important contributions. First, it alters the tonal balance of the sound. The direct field tends to be "bright," somewhat bass-shy; the reverberant field contains most of the bass energy and markedly lacks treble, as most halls tend to boost the bass through reverberation and to roll off the highs through absorption. The combination at the ear of the tonal balances of the direct and the reverberant fields yields the pleasing, mellow sound characteristic of a good hall.

The reverberant field adds also to the impact of the music on the listener. The sense of involvement in the music is greatly enhanced by immersion in the sound, rather than by mere presentation of it. In fact, the reverberant field is typically much stronger than the direct field. We're just not aware of it, because the direct sound reaches us first.

Reproduction of the reverberant field in the home became the ambition that launched quad, which, Titanic-like, only foundered on the shoals of faction and sensationalism. Various manufacturers began promoting different and incompatible four-channel reproduction systems, all of which suffered from grievous problems: restricted bandwidth, distortion and noise, vocalists and instruments that shifted suddenly from in front of the listener to behind him, etc. Meanwhile, the record companies, who apparently thought mere ambience-recovery too subtle for the mass market, were busy churning out "surround sound." For the first time, everyone, audience included, could sit in the orchestra. Several years later, quad is virtually dead.

Quad did not sink in vain. From its wreckage comes the audio delay line. The objective is the same — to create the illusion of being in a hall or club — but the means are altogether different. Delay lines do not, strictly speaking, reproduce hall ambience. Instead, they simulate it and avoid in the process most of the problems that plagued quadriphonics. No special records are necessary and, when the devices are used properly, no sonic travesties are produced. The simulation is accomplished by means of electronically derived delays and reverberations played through a pair of rear speakers.

Devices that could do this sort of thing have been around for a while, but their prices used to start at several thousand dollars — a little out of range for home audio. But recent technological innovations and new integrated circuit devices have reduced production costs dramatically. Consequently, the first consumer audio delay lines are just now becoming available. Tweeter Etc. is the exclusive dealer in the Boston area for the Sound Concepts SD-50, which is now in the stores at a price of $600. Around the end of March, the Audio/Pulse Model One, at $585, will come on the market at Tweeter and at Suffolk Audio. The represent a considerable advance in the art of high-fidelity reproduction.

Neither unit affects the signal that passes through the front speakers. Both systems process that signal in several steps, then feed the resultant signal to the rear speakers.

The SD-50 begins by cutting the signal off above 10 kHz. In each channel, a compander circuit with a frequency-weighting network, similar to a dbx, reduces noise during the rest of the signal processing. Next the input goes to the compressor and high-frequency preemphasis circuits. After that, it enters the device that is the heart of the system.

A digital clock, whose rate is controlled by the delay knob on the front panel, causes a "bucket-brigade" integrated circuit, or IC, to sample the signal at regular intervals. With each "tick" of

Continued on page 36

"It's simply amazing how good an old mono disc can sound when one of these units goes to work on it. The sound of any disc takes on a warmth, body and dimensionality that just aren't there without delay . . . . On concert recordings, it sounds as though one is actually sitting in the audience, surrounded by people. But, at the same time, the effect is subtle. One isn't aware of the sound from the rear speakers, but the effect of switching them out is dramatic."

HOW TO MAKE YOUR OWN *NUTCRACKER SUITE*

Turning your home into a recording studio

by Peter W. Mitchell

You don't have your own recording contract yet, but you want to be recorded — either for broadcast on local stations or to obtain an audition/demo recording which you and your agent can peddle to the record companies.

You could hire one of the local professional studios for an hour, a day, or as long as it takes to get your sound recorded the way you want it. That's a sensible approach, *if* what you want is a "documentary" recording of your performance. If you are well rehearsed, then a two- or three-hour session at a studio should be enough to establish correct mike placement and get several complete "takes" recorded. A good professional studio can do this for you at a reasonable cost.

But what if things aren't that simple? If you want to use the recording medium as an experimental "test bed" to develop and refine sounds and performance possibilities which are conceived expressly for the recorded medium itself, you could find yourself owing the studio thousands of dollars for the use of their time, equipment and expertise.

Rolling Your Own

The practical alternative, which more and more musical groups are adopting, is to buy some recording equipment and set up your own mini-studio at home. Of course you're not seriously going to compete with the professionals at their own game, but you probably don't really need all the flexibility and efficiency that the big studio offers. After all, what you are mainly paying for at a studio is the expertise of the engineers and the use of an elaborate $20,000 console with its associated gear. While the 24-channel console is useful for really complex recording jobs, its principal benefit is the efficiency with which rather complex setups can be recorded. The same is true of the expertise of the studio engineers — they don't do anything magical to the sound, but they may find the optimum mike position or mixing balance a lot quicker than you will. If you've got more time than money, you can roll your own tapes and refine your skills as a recording artist, all on your own time at home. With good consumer-grade equipment you can produce recordings which are close enough to studio quality that the difference may not matter. The main difference, really, is that without the flexibility of the studio equipment and the expertise of the studio personnel, it will take you a lot more time to produce good results. But it's *your* time; you won't be paying anybody $50/hour while you experiment with miking, or while

Continued on page 8

TURN IT UP.

Don't buy any loudspeaker until you test drive it. You're not going to a recital. You're choosing a roommate.

Challenge it. Put it through its paces. Most loudspeakers can handle mid-range, mid-volume, mid-mid sound. That's no test.

Turn it up! Really loud. Loud loud. Kid-next-door loud.

How does the loudspeaker sound? Do you like it? Is it clean? Is it clear? Does it hum? Does it splatter? Is it fuzzy or distorted?

Loudness magnifies the imperfections that will scar your subconscious at regular listening levels. Loudness tells you what time will do to your ears, your head, your disposition. Now:

TURN IT DOWN.

Way down. Take it to the edge of silence, and then come back a little.

Can you hear every part of the music? Are all the textures and detail and harmonics of the music still there, or is only the melody lingering on?

Nobody wants to live with a loudspeaker that can't make its point unless it yells. So. Turn it down.

One last thought: You shouldn't have to judge a loudspeaker while you're listening to three other speakers, six other conversations and a partridge in a pear tree.

If you're serious about sound, find someone who's serious about helping you. Find a dealer with proper demonstration facilities. That's easy.

If it says "Authorized JBL Dealer," relax, friend. You've come to the right place.

JBL offers a number of different high fidelity loudspeakers from $156 to $3210. Shown here, from left, are L36, L166 and L300. They are priced at $198, $375 and $897 each.

JBL

Now that you know how, here's where:

Boston
Copley Camera & Hi Fi
480 Boylston St.

Brockton
Tweeter Etc.
849 Belmont St.

Tech Hi Fi
375 N. Montello Rd.
Route 28

Brookline
Tech Hi Fi
870 Commonwealth Ave.

Tweeter Etc.
163 Amory St.

Cambridge
Minute Man Radio Co., Inc.
30 Boylston St.

Tech Hi Fi
30B Boylston St.
Harvard Square

Tweeter Etc.
102 Mt. Auburn St.

Chestnut Hill
Tweeter Etc.
Chestnut Hill Mall

Dedham
Tech Hi Fi
856 Providence Hwy.
Route 1

Fitchburg
Fitchburg Music
175 Main St.

Framingham
Tech Hi Fi
280 Worcester Hwy.

Hanover
Tech Hi Fi
Route 53

Hyannis
Nantucket Sound
Cape Cod Mall

Lawrence
Minute Man
Radio Co., Inc.
406 Essex

Nashua
Tech Hi Fi
Nashua Mall Extension

North Dartmouth
Nantucket Sound
Dartmouth Mall

Providence
Audionics, Inc.
790 North Main St.

Swansea
Nantucket Sound
Swansea Mall

Waltham
Waltham Camera
& Stereo
365 Moody St.

Worcester
Tech Hi Fi
279 Main St.

GETTING YOUR KIT TOGETHER

A buyer's guide to assembly lines

Photos by Cliff Garboden

by James Brinton

There are only three reasons today to buy a hi-fi kit: assembly of the kit gives you pleasure, the kit supplies some feature or set of features you can't get elsewhere or you want to save money.

There is, of course, a lot of other patter going around — most of it illusory. To wit, some falsehoods:

• Kits give more value for money than assembled units. Rarely true: most kits cost either about the same or a little more than assembled units.

• Kits teach you about electronics as you assemble them. This is a laugher. As set forth by their makers, kits are little more than three-dimensional jigsaw puzzles held together with solder. What did you last learn from a jigsaw puzzle?

Should you still be interested? Yes, because while most kits cost more (relative to assembled units) than their pushers would have you believe, there are bargains out there if you are willing to look for them.

Almost everybody's heard of Heathkit or Dynaco, and both these companies offer lines of electronics and speakers that compare well with the best available already assembled units. But there are other firms with other wares (see box, "Who's Selling What?"), and several companies make speaker kits, music synthesizers, test gear for audiophiles and kits that improve the performance of your existing equipment. Some kits are a little esoteric — like Old Colony Sound's performance improvement package for Advent's Model 101 Dolby-B unit — but that is the beauty of the kit business. It is sometimes possible to offer a kit where an asembled unit would demand too much overhead in terms of labor or plant (and thus be too costly to sell already constructed).

It is in these areas that kits tend to be the best bargains. Where kits compete with widely available, assembled, mass-produced products, their value becomes a matter of individual taste. They can cost even more than their assembled counterparts — so much for trading your labor for a low price; it doesn't work that way very often (see box, "Is That Kit Really a Bargain?").

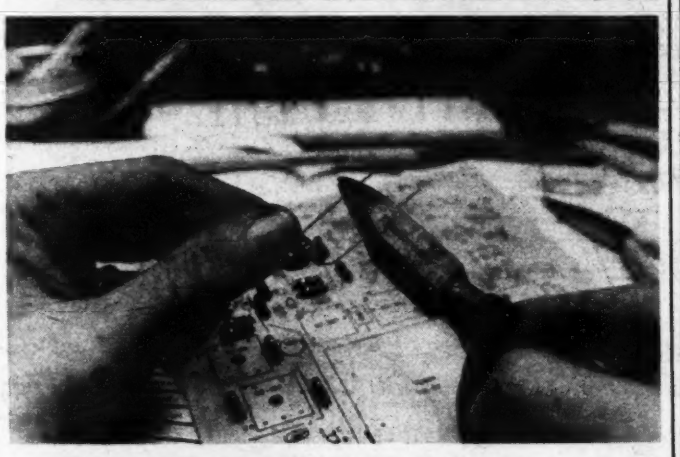
Can You Do It?

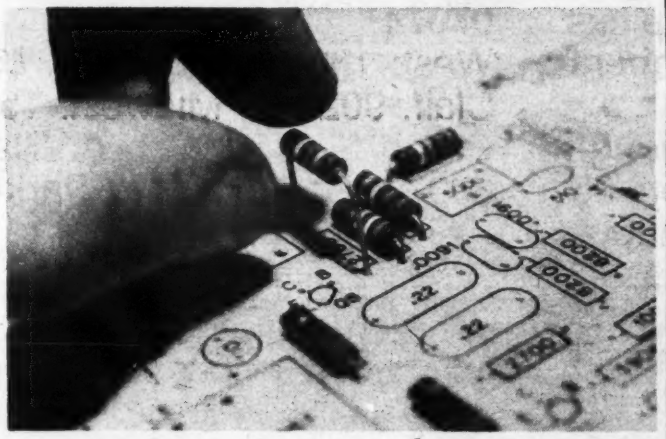
But assuming you find a kit you want, can you manage to put it together? Almost certainly — although we've got a few tips to help you along the way.

The instruction manuals supplied with kits, especially Heath and Dynaco's, are well-written, well-illustrated and unambiguous. Those from lesser companies often assume a little more knowledge on the part of the buyer and sometimes can confuse the neophyte. Generally, though, if you can read and understand English, follow instructions and exercise common sense, you can build a kit.

Before its sexism was recognized, it was industry practice at kit firms to give a kit and instruction manual to one of the stenographers. The idea was that if a non-technical female could put the kit together with those instructions, anybody could, and further, that her mistakes would

Continued on page 38





Installing a resistor is shown in the above photos: (top) bending and trimming the conductors; (middle) placing the resistor on the component side of the circuit board; (bottom) soldering the conductors on the foil side of the board.

MASSACHUSETTS

Auburn
Impulse

Billerica
Lafayette Radio

Boston
Atlantis Sound
Copley Camera
Lafeyette Radio
Tech HiFi
Eardrum
Music Center of Boston

Brockton
Tweeter, Etc.
S&E Audio

Brookline
Tweeter, Etc.

Burlington
Lafayette Radio
Eardrum

Cambridge
Atlantis Sound
Lechmere Sales
Tech HiFi
Tweeter, Etc.
Eardrum

Chelmsford
Radio Shack

Chestnut Hill
Tweeter, Etc.

Cohasset
Olde Colony Stereo

Danvers
Lechmere Sales

Dartmouth
Pina Audio

Dedham
Lechmere Sales
Tape Place
Tech HiFi

Falmouth
Harmony Hut
Ortin's Photo

Fitchburg
Fitchburg Music

Framingham
Atlantis Sound
Tech HiFi

Hanover
Olde Colony Stereo
Quantum Sound

Hyannis
Nantucket Sound

Lawrence
Malco Electronics

Leominster
Electronic Werld

Nantucket
Grey Electronics

Natick
Lafayette Radio

Needham
You-Do-It

Peabody
Atlantis Sound

Quincy
Olde Colony Stereo

Raynham
David B. Dean Co.

Salem
Highland Sales

Saugus
Lafayette Radio

Stoneham
Tech HiFi

Waltham
Tech HiFi
Waltham Camera

Watertown
K&L Sound

W. Bridgewater
Tape Place II

West Roxbury
Lafayette Radio

Worcester
Atlantis Sound
Leib Electronics
Tech HiFi

NEW HAMPSHIRE

Claremont
Radio Shack

Dover
Radio Shack

Hanover
Dartmouth Audio

Keene
Melody Shop
Radio Shack/Hew

Laconia
Inner Ear

Concord
Lafayette Radio

Salem
Radio Shack

Seabrook
Radio Shack

Manchester
Lafayette Radio
Bi-Rite Mdsers.

Nashua
Tech HiFi
Atlantic HiFi

Rochester
Lafayette Radio

Portsmouth
Radio Shack

RHODE ISLAND

Bristol
Delta HiFi

Coventry
Stereo World

N. Kingston
Stereo World

Providence
Atlantis Sound
Lafayette Radio
Apex
Stereo Places
Tech HiFi
Impulse
Twin City Music House

Warwick
Tech HiFi
Apex
Impulse

Woonsocket
Ed's TV

W. Warwick
Joe's Stereo

The new SX-737. So much for so little.

With its extraordinary engineering, advanced design concept and extreme flexibility, Pioneer's new SX-737 AM-FM stereo receiver offers a level of performance that can only be described as awesome.

Its exceptional FM reception is achieved through the use of phase lock loop circuitry, ceramic filters, a dual-gate MOS FET. So it cleanly and clearly picks up stations that were once just numbers on the dial — without interference.

The SX-737 has more than enough power to satisfy your needs. It delivers 35 watts per channel, minimum continuous power, 20Hz— 20kHz, maximum total harmonic distortion 0.5% at 8 ohms. And all of this power is smooth and stable with dual power supplies driving direct-coupled circuitry.

If you equate performance with versatility, you'll find the SX-737 unsurpassed in its price range. It accommodates every listening interest with a complete range of connections for two pairs of speakers, turntable, tape decks (with tape-to-tape duplication), headphones and microphone. And it offers an exclusive Recording Selector that lets you record FM while listening to records, or vice versa.

All of this performance requires the proper controls to handle it. And the SX-737 gives you the kind of control mastery you deserve. Click-stop tone controls. . . high/low filters. . . loudness control. . . dual tuning meters. . . and FM muting.

The SX-737 is under $400* — including the cabinet. If, by chance, you're looking for even more power and additional features, the SX-838 is under $500*. Both deliver the awesome level of performance that is typical of Pioneer excellence.

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074
West: 13300 S. Estrella, Los Angeles, Claif. 90248 / Midwest: 1500 Green leaf, Elk Grove Village, Ill. 6007 / Canada: S.H. Parker Co.

Specifications	SX-737	SX-838
FM Sensitivity	1.9 uV	1.8 uV
Selectivity	60 dB	80 dB
Capture Ratio	1.0 dB	1.0 dB
S/N Ratio	70 dB	70 dB
Power	35 watts per channel, minimum continuous power, 20-20,000 Hz, with maximum total harmonic distortion 0.5% at 8 ohms.	50 Watts per channel, minimum continuous power, 20-20,000 Hz, with maximum total harmonic distortion 0.3% at 8 ohms.

PIONEER®
when you want something better

SX-838 AM-FM Stereo Receiver

*The value shows is for informational purposes only and includes a cabinet with walnut grained vinul top and side panels. The actual resale price will be set by the individual Pioneer dealer at his option.

RECORD

Continued from page 4

you record five ways of phrasing a melody to see which sounds best on playback.

It may surprise you to learn that a $500 consumer tape deck can make recordings as good as those from a $4000 studio machine. But it's true. The expense of a studio recorder is related to its ruggedness, since it may have to operate all day every day without a breakdown. If your doubts about high-quality home recording are based on the amateur recordings you've heard, it is a good bet that the mediocre sound wasn't the recorder's fault. Lousy amateur recordings usually are the result of cheap microphones badly placed. So we'll look at microphones first.

Mikes: The Recorder's Ears

The biggest mistake that most people make when they set up a home recording studio is they begin by investing three months' income on a 50-pound multitrack tape recorder having 17 knobs and switches for every conceivable "feature" — leaving the choice of microphones as an afterthought. A smarter approach is to begin by buying a pair of good professional-quality microphones. They are the least costly part of a recording system, but they are responsible for the sound you get. Teach-yourself how to use them, employing any decent stereo tape recorder you can lay your hands on for your trial recordings. A basic 7½ ips quarter-track stereo deck (made by Sony, Teac, Tandberg, etc.), or a Dolbyized cassette deck (by Advent, Nakamichi, Sony, Teac, etc.) will be amply good enough to reveal differences among microphones and — more important — the differences in recorded sound due to the placement and aiming of the mikes.

Microphones are a recorder's ears. If you use cheap, half-deaf mikes your recordings will reveal that. Mikes are available that cost as little as $10 and as much as $1000, but most good-quality professional mikes cost between $50 and $250 each. You will find that microphone specifications tend to be skimpy and confusing, and judging the sound quality of a mike from its specs is impossible. You can only judge a mike by using it — and then you will find that the placement and aiming of the mike affects the sound as much as does the quality of the mike itself.

There is no universal agreement on which are the "best" mikes; every recordist has his or her own preferences. So it usually is a waste of time to try to choose "ideal" mikes for your work. Just get some good ones, mikes which are generally respected by experienced recordists, and start learning how to get the best sound out of them.

Microphone Vocabulary

The basic terms that are used in describing microphones are: the transducer type, the directional pattern, the impedance, the sensitivity and the output wiring. The frequency-response data that are given often are meaningless, and even when accurate are hard to correlate with the mike's sound, so don't waste your time trying.

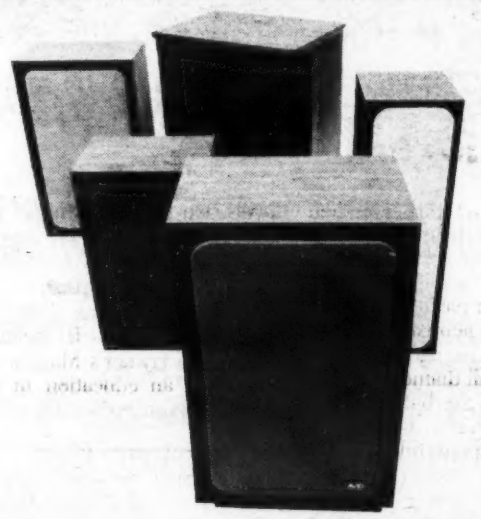
Transducer. There are four common types: dynamic, ribbon, condenser, electret. Dynamics are the most common, give good performance at modest cost, and can in most cases handle very high loudness levels without distortion. But they usually don't reproduce the very lowest and very highest audio frequencies perfectly, and they tend to be sensitive to vibration and handling noise. Ribbon mikes are relatively rare; they can give lovely reproduction of subtle instrumental sounds but in some cases can be ruined by a screaming vocal. Condenser (capacitor) mikes occupy the highest-priced, highest-quality end of the microphone market; in addition to the most accurate low-end and midrange response they can have excellent highs. But they require a power supply (an added expense), and some of them distort when handling very loud sounds; try to choose a model whose distortion is specified to be low, up to 130 dB SPL or so. The "electret" is a recently developed, cheaper form of condenser mike; it is capable of the flat low-end and midrange response of condenser mikes, and some are excellent at high frequencies as well. But some electrets exhibit high-frequency sibilance on vocals, and most will distort at very high loudness levels.

Directional pattern. There are three common patterns: omni (all)-directional, bi (two)-directional, and uni (one)-directional. An omni-directional mike is equally sensitive to sounds arriving from all directions, except that at high frequencies it tends to become uni-directional. With an omni mike you can increase the high-frequency crispness in the sound by aiming the mike directly at the vocalist or instrument, and can reduce the top-end emphasis by aiming the mike to the side or up at the ceiling so that the sound arrives at the mike from its side. A bi-directional mike is sensitive to sounds arriving at the front and back, but not to sounds arriving at its sides; usually only ribbon mikes have this pattern.

A uni-directional or "cardioid" mike is sensitive to sounds arriving from a broad arc in front of it, and is moderately sensitive to sounds arriving at its sides, but it is relatively insensitive to sounds arriving at its rear. So the principal use of a cardioid mike is to *reject* an unwanted sound by pointing the mike directly away from it (and more-or-less toward the sounds you do want to capture). This rejection property is handy for PA systems, where you don't want a mike to pick up its own sound from the speaker and cause a "feedback" howl. But in recording the value of uni-directional mikes tends to be overrated.

Impedance. Mike impedances (Z) come in two categories: high (many thousands of ohms) and low (from 50 to 2000 ohms or so, but usually under 600 ohms). Usually high-Z mikes are used in PA systems and low-Z mikes are used in professional recording. If you already have some high-Z mikes you might as well try to use them for recording and see how well they work out (assuming that your mike preamp or mixer has the appropriate high-Z inputs). But when buying new mikes, stick to low impedance. Among low-Z mikes the exact value of the impedance is unimportant.

Sensitivity. Microphone sensitivity specifications are a confusing mess because there are several rating systems in use. For



Before we started making speakers, we made something else.

A commitment.

The most acclaimed new line of speaker systems on the market today didn't get there by accident.

At Avid, we're totally dedicated to just one thing and one thing only: the design and construction of the cleanest-sounding, most accurate speakers in their price range. Each and every one.

And that's not just so much advertisingese. It's for real. And we're not the only ones who think so.

"A BEST IN ITS CLASS . . ."
High Fidelity–August, 1974/Avid 100.

"EXTREMELY SMOOTH AND NEUTRAL . . ."
Len Feldman, FM Guide–December, 1974/Avid 102.

"UTTER SMOOTHNESS AND FREEDOM FROM UNDUE EMPHASIS OR COLORATION . . ."
Julian Hirsch, Stereo Review–April, 1974/Avid 103.

"ONE OF THE MORE SENSATIONAL HIGH-FIDELITY BUYS OF OUR TIME . . ."
Modern Hi-Fi & Stereo Guide–November, 1974/Avid 60.

But it's not what we think, or even what the critics think, that's important. It's what you think.

Listen to an Avid speaker for yourself, today.

AVID® CORPORATION
10 Tripps Lane / East Prov., R.I. 02914

AVAILABLE AT: ☐ **All Lechmere Stores:** Cambridge, Dedham, Danvers, Springfield, MA ☐ **Fred Locke Stereo:** Springfield, MA ☐ **Malco Electronics:** Lawrence, MA ☐ **Images, Sight & Sound:** Fall River, MA ☐ **All Ear Drum Audio Stores:** Cambridge, Burlington, Boston, MA ☐ **Impulse, Inc.:** Auburn, MA ☐ **Tripod Audio:** Amherst, Northampton, MA

A lot of headphones hurt. After a few minutes they begin to weigh you down. A few minutes longer, and they start building a tiring pressure on your ears. They hurt too much to keep on your head.

Or you can slip on the new lightweight AKG K-140 headphones. They automatically adjust to the contour of your head. (With our exclusive Cardan® swivel and supra-aural design, the 140 doesn't have to make a squeeze fit.) So there's no ear pressure. And no thumping head. You can listen for hours. Painlessly.

The 140 also lets you enjoy music at high sound levels without punishing your ears. Yet, you can hear your environment because the 140 won't isolate you. After all, music isn't played in a vacuum. But don't worry, no one will be disturbed when you wear a 140.

We designed the 140 for professional monitoring. Which means wide bandwidths and low distortion, and sound pressure levels over 115 dB. The 140 is compatible with all outputs, 4-600 ohms. Weight: a scant 6.2 ounces. Price? That's so scant it won't give you a headache either. $34.50.

AKG MICROPHONES • HEADPHONES
distributed by:
PHILIPS AUDIO VIDEO SYSTEMS CORP.
AUDIO DIVISION
91 McKee Drive, Mahwah, New Jersey 07430
A North American Philips Company

The headphone without the headache. Introducing the AKG K-140.

®— AKG, Vienna

example, some ratings give the mike's voltage output at a sound pressure level of "one microbar." Another rating method gives the mike's power output at a sound pressure level of 94 dB SPL which is equal to a pressure of 10 dynes/cm², which is the same as 10 microbars. In either case the actual rating will be given as a negative number of decibels, e.g., "-73 dB," often with no clue as to which rating reference is in use. In such cases the number itself is a clue: if it is between -60 and -80, it probably corresponds to one microbar; if between -35 and -60, the 10-microbar level probably was used. When evaluating mike specs, you should convert any one-microbar rating to the 10-microbar level in order to make comparison possible. With low-impedance mikes this can be done accurately enough simply by adding 20 dB; thus a mike rated at "-73 dB" will have an output of approximately -53 dB at the standard 10-microbar level.

The importance of straightening out this confusion is that the mike's sensitivity spec tells you something about its compatibility with your mike preamp or mixer. If you use a low-output mike to record a loud source you probably will get good results. But if you use a low-output mike to record soft sounds (such as a classical nylon-stringed acoustical guitar), your mike preamp will contribute audible hiss to the recording, making it desirable to use a very low-noise preamp such as the Advent MPR-1. A high-output mike used on the classical guitar will deliver enough signal to overcome preamp and mixer noise with ease. But if you use the high-output mike to record very loud sources (screaming vocals with the singer "eating" the mike, or heavy piano chords with the mikes stuck inside the piano over the strings), the mike's excessive output will overload the preamp inputs and cause distortion regardless of the setting of the level controls on the mixer or recorder. In this case you would have to change mikes or buy attenuators ($15 each) for the mike cables in order to reduce the signal levels.

How high is high? At the 10-microbar reference level, a "high-output" mike would be rated at between -35 and -45 dB, approximately. A "low-output" mike will be in the -50 to -60 dB range. In general, dynamics and ribbons tend to have relatively low output, while condenser mikes often have rather high output levels.

You may also encounter "EIA" sensitivity ratings. In this system a rating of -145 to -155 dB is "low" output and -130 to -140 is "high" output.

The *output wiring* of the mike also affects its compatibility with the mike preamp or mixer. Cheap consumer mikes normally are supplied with an "unbalanced" two-wire cable (signal lead plus shield), usually terminated in a phone plug, and the mike inputs on consumer tape recorders are designed to accept this kind of input. But professional recording mikes generally employ "balanced" three-wire cables (two signal leads plus shield), providing much greater immunity to hum and radio interference; such cables may terminate in a three-conductor phone plug or, more commonly, an "XLR" plug. As a temporary expedient you can use professional mikes with a consumer tape recorder by obtaining line transformers ($15 each) which will convert your recorder's mike inputs to accept balanced-line mikes. Eventually you will probably want to get a good outboard mike preamp or mixer whose outputs can be fed to the line-level inputs of your recorder.

Getting Started with Mikes

If you are going to do a great deal of creative recording, you may want several pairs of mikes having various characteristics. But to get started you should choose one good pair of reasonably economical mikes and start learning how to place them for good sound. If you will be recording a lot of vocals or very loud instrumentals, start with a good pair of dynamic mikes in the $50 to $100 range, such as the Advent MDC-1 (uni-directional), AKG D160E (omni), Beyer X1N (uni), or Electro-Voice DO54 (omni). If you will be recording mostly instrumentals at ordinary loudness levels, get some good electrets in the $100 range such as the Sony ECM-22 (uni), the new AKG CE-1 series (omni or uni), the Group 128 mike (omni), or the Boston Audio Society mike (omni).

Later, after you gain recording experience and start getting your money's worth out of your home studio, you may want to invest in some really top-class dynamics such as the E-V RE-55 or RE-15 ($190), ribbons such as the Beyer M500 ($140) or M160 ($260), and condensers such as the Neumann KM-83/84 ($230) or AKG C451E ($200).

Atlas mike-stands and "baby booms" are almost universally used in studios because they work OK and are fairly cheap ($10 to $15). There are some very nice European stands and booms distributed by AKG and Beyer dealers, but they cost twice as much money.

When you start recording you immediately discover the problem of room acoustics. Recording studios are usually quite "dead" acoustically so that the mike will hear only the direct

Continued on page 11

Fig. 1

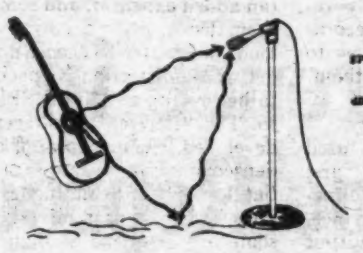
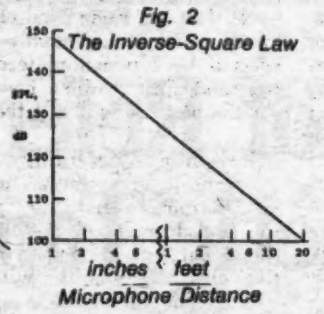


Fig. 2



When a good friend tells you "I can't afford Interface:A," tell her about the new Interface:B.

Our new Interface:B is a way of acquiring most of the excellence of our vented, equalized Interface:A speaker system for much less money. Interface:B is friendly advice in another way too: we designed it to work with lower powered electronics and still provide superior sound at satisfying levels.

Flat, accurate response here. Less than 2¢ a Hz.

Below the lowest reach of a bass guitar is a whole acoustical world that's costly to reproduce. And most speakers miss it. Yet down there, Interface:B responds with startling accuracy to a 36-Hz tone. We used an Interface:A technique to achieve this; it is not unlike squeezing a 16-foot organ pipe into a box of true bookshelf size. The device that enables this is the same vent substitute we developed to meet the design goals of the Interface:A. It looks like an extra woofer, but it duplicates the function of a column of air ten inches in diameter and nearly 20 feet long.

Highs the way the composers wrote them.

In the midrange, most high-efficiency bookshelf speakers in the Interface:B price class come on strong. Overly so, we think. On top of that, many don't disperse their high-frequency output uniformly, either. We haven't resorted to these design tradeoffs in Interface:B. Interface:B puts out an earful of uncommonly uniform acoustic power because, first, its midrange is radiated by a relatively small diameter driver, plus it has a simple but effective acoustic lens on the tweeter combined with a compensating amount of high-frequency boost from the equalizer.

We mixed the equation so that B equals A, nearly.

So that lower powered receivers could be used with Interface:B, we altered the mathematics of Interface:A's enclosure. About an inch increase in size all around permits, with only a 4-Hz change in low-frequency limit, a conversion efficiency fully 3 dB higher than Interface:A. So it takes half the power to drive Interface:B's to the same volume level.

And so that subsonic signals such as record rumble don't distort the flat response of Interface:B, we designed the equalizer to roll off sharply below 36 Hz.

A-B our new Interface:B against the higher priced systems.

For accurate response, superior dispersion, and deeply satisfying levels, we think practically nothing beats our Interface:B (except our Interface:A). Give us a hearing.

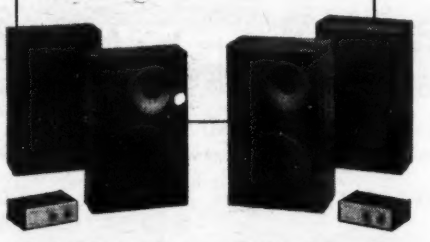
Free manual.

Send for our free Interface information package. It includes an Interface:B Owner's Manual that is practically an education in vented speaker design and application.

Dept. 364BP, 635 Cecil St.
Buchanan, Michigan 49107

Electro-Voice® INC
a gulton company

Specifications	Interface:A	Interface:B
Response, On Axis	32—18,000 Hz, ± 3 dB	36—18,000 Hz, ± 3 dB
Total Acoustic Power Output	32—18,000 Hz, ± 3 dB	36—18,000 Hz, ± 4½ dB
Sound Pressure Level (1 Meter, 1-W In)	89 dB	92 dB
Suggested Amplifier Power Rating (RMS per channel at 8 ohms)	Minimum: 10 Watts Maximum: 250 Watts	Minimum: 5 Watts Maximum: 180 Watts
Long-term average power handling capacity (midband)	25 Watts	18 Watts
Peak Power Handling Capacity (midband) (10 milliseconds)	250 Watts	180 Watts
Dimensions	14" x 22" x 7¾" deep	14" x 23" x 9¼" deep
Suggested Retail Price (Slightly Higher in Western States)	$450.00 per pair including equalizer	$325 per pair including equalizer



Interface:A Interface:B

See and hear Interface:A and Interface:B at these stores:

ALL TECH HIFI STORES

Boston	Cambridge	Hanover	Stoneham	Hanover, N.H.	Providence, R.I.
Brockton	Dedham	Northampton	Waltham	Nashua, N.H.	Warwick, R.I.
Brookline	Framingham	Quincy	Worcester		

IMAGES SIGHT & SOUND
Fall River

OLDE COLONY STEREO
Quincy & Hanover

SOUND TRACK
Woonsocket, R.I.

A Point of Reference in Quality Magnetic Tape Reproduction

Re·cord /ri-ˈkȯrd/ *vb:* to cause sound or visual images to be registered as on a phonograph disc or magnetic tape in a form that permits reproduction.

Am·pex /ˈam-pecks/ *vb:* a level above record. *cf* **record.**

Don't Just Record It. AMPEX IT.

AMPEX

Words. So many words on a page. But the meaning of words is sometimes in their difference of reliability and quality. Like record. Like AMPEX.

Discover for yourself the difference in professional reliability built into every AMPEX cassette, 8-track cartridge and open reel.

Discover what a difference this professional quality can make on your equipment.

Try AMPEX blank tape in your home. Made with the same know-how that goes into AMPEX studio mastering tape, acknowledged by recording engineers around the world as the finest professional mastering tape available.

AMPEX is the # 1 name in studio recording — make it the # 1 name in your home recording.

There is a difference.

You may purchase AMPEX Magnetic Tape at any of these fine audio dealers in New England.

AIRPORT SALES
Leominster

ARKAY AUDIO
Watertown

BI-RITE
Manchester

BRIGGS & BRIGGS
Cambridge

THE COOP
Harvard Square
MIT Student Center

DeMARCO ELECTRONICS
Haverhill

IMAGES SIGHT & SOUND
Fall River

JORDAN MARSH
Boston (Wash. St. Store only)

K & L SOUND
Watertown

LECHMERE SALES
Cambridge
Dedham
Danvers
Springfield

MINUTEMAN
Cambridge
Lawrence

NANTUCKET SOUND
Hyannis
No. Dartmouth
Swansea

OCEAN ELECTRONICS
Leominster

STEREO PLACES
Providence, R. I.

TAPE PLACE
Dedham

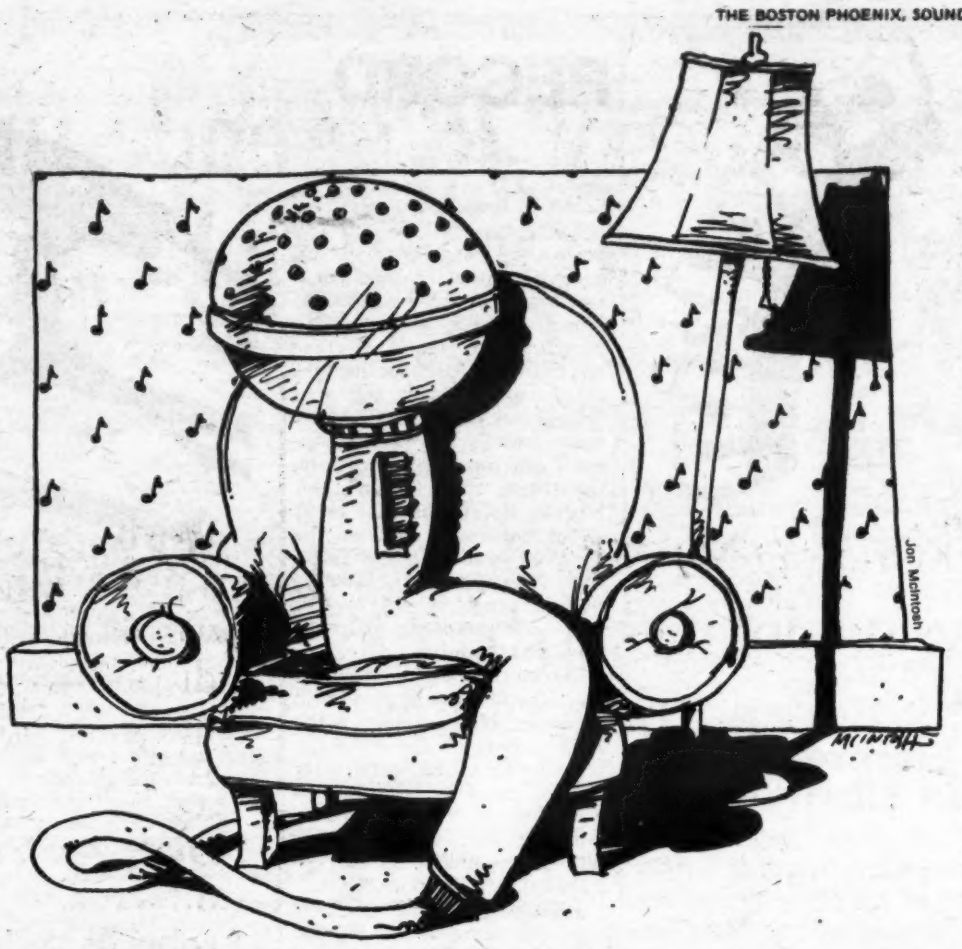
TAPE PLACE II
W. Bridgewater

THE STEREO PLACE
Framingham

RECORD

Continued from page 9

sound from the instruments, uncolored by room reflections. At home you don't have this luxury, so you have to learn to recognize and deal with room coloration in your recordings. Start by setting a mike on a stand, move back six feet, and record yourself talking or playing something. When you play back the tape you will find that it sounds as if you were in a barrel. Part of the problem is "phase cancellation" as illustrated in figure 1. Some sound waves go directly to the mikes and other sound waves bounce off the floor or walls or ceiling. At some frequencies the reflected waves reinforce and at other frequencies they cancel out the direct sound. The cure for this problem is to *get the microphones close*. If the mike is just six inches from the instrument or singer, the direct sound will be much stronger and the reflected waves won't matter (as long as the mike itself is not close to a reflecting surface).



Close-miking involves two common problems of its own which you should be aware of. One is the "inverse-square" law, which means that moderate changes in distance from a mike produce noticeable changes in recorded sound level. If someone who is six inches from a mike leans back in the middle of a phrase and is suddenly 12 inches from the mike, the doubling of distance will drop his recorded level by 6 dB (a factor of four in acoustic power). Of course this phenomenon can be useful: one aspect of a good performer's mike technique is to lean close to the mike when crooning a soft solo and lean back a bit when wailing a big climax. This helps to even out the variations in loudness, making it easier for the tape recorder to do its job well.

Figure 2 illustrates the inverse-square law, in this case for a very loud sound whose sound level at a 20-foot distance would be 100 dB SPL. The loudness level at a distance of six inches or a foot is much higher than it is 20 feet away. The rapid increase in level as a mike comes close is why mike and preamp overload can be a problem in close-miking, requiring the use of dynamic mikes (or attenuators with condenser mikes) for recording very loud sounds.

The other problem in close-miking is "proximity boost." Omni mikes don't have this problem. But many uni-directional (cardioid) microphones become boomy in the bass when placed close to a sound source. To counteract this somewhat, cardioid mikes usually have rolled-off bass response. This is one reason why I tend to prefer omni mikes for studio recording; their bass response is smoother and more consistent at all mike locations. Of course in some cases proximity boost can be useful — to enrich a male vocal that would otherwise be too thin-sounding, for example.

The goal at this stage in this establishing of your home studio is to get to know your mikes the way you know your instrument. Using one mike at a time, make monophonic recordings of anything — yourself, all the instruments that you can play, any other musicians who will serve as willing subjects. Vary your mike placement and aiming until you know how your mikes respond to all instruments, near and far, high and low. In the final analysis, all your skill as a recordist depends on being able to place the mikes correctly to capture the sound of each instrument accurately.

There are no certain rules for mike placement, but here are some suggestions. In each case the mikes should be fairly close, not more than 10-15 inches from the instrument.

Piano. With a grand, raise the top and aim two mikes at the string and sounding board — one to cover the high strings and the second to cover the bass strings. The closer the mikes are to the strings and hammer area, the more bright and clangy the sound will be; as the mikes are

Continued on page 12

THE BEST!

audio research

That's what State-of-the-Art means . . . . the best. What we mean when we underline it is that we recognize Audio Research high definition components as the finest available. Anywhere. (For any price).

You can experience this for yourself at Fred Locke Stereo in Avon or New Haven, Ct. We're Connecticut and Western Massachusetts' largest audio specialists and Audio Research's foremost dealer in New England.

. . . . And we don't take our underlinings lightly.

Shown at left: Tympani 1-C panel speakers, D76A power amplifier, SP-3A-1 pre-amplifier

FRED LOCKE STEREO

AVON
216 West Main Street
203-687-1794

NEW HAVEN
1533 State Street
203-787-0183

SPRINGFIELD, MA • NEWINGTON • ORANGE
• EAST HARTFORD
WATERBURY • STRATFORD • NEW LONDON • FAIRFIELD CT

With an Empire wide response cartridge.

A lot of people have started "trackin" with Empire cartridges for more or less the same reasons.

More separation: "Separation, measured between right and left channels at a frequency of 1 kHz, did indeed measure 35 dB (rather remarkable for any cartridge)." **FM Guide, The Feldman Lab Report.**

Less distortion: "...the Empire 4000D/III produced the flattest overall response yet measured from a CD-4 cartridge—within ±2 dB from 1,000 to 50,000 Hz." **Stereo Review.**

More versatile: "Not only does the 4000D/III provide excellent sound in both stereo and quadriphonic reproduction, but we had no difficulty whatever getting satisfactory quad playback through any demodulator or with any turntable of appropriate quality at our disposal." **High Fidelity.**

Less tracking force: "The Empire 4000D/III has a surprisingly low tracking force in the 1/4 gram to 1-1/4 gram region. This is surprising because other cartridges, and I mean 4 channel types, seem to hover around the 2 gram class." **Modern Hi Fi & Stereo Guide.**

More accurate: "Audio fans accustomed to hearing a bit of 'sizzle' at the high end (usually the result of false resonant peaks above 10 kHz) may have to get used to this truly flat and accurate reproduction as heard with an Empire 4000D/III." **Radio Electronics.**

For the complete test reviews from these major audio magazines and a free catalogue, write:

Empire Scientific Corp., Dept. V
Garden City, N.Y. 11530

EMPIRE

Model	Frequency Response in Hz	Channel Separation	Tracking Force in Grams	For Use In	Stylus Color
4000 D/III	5-50,000	more than 35dB	¼ to 1¼	turntable only	White
4000 D/II	5-45,000	more than 35dB	½ to 1½	turntable only	Yellow
4000 D/I	10-40,000	35dB	¾ to 1½	turntable or changer	Black

Plays 4 Channel Discrete (CD4), Super Stereo, and All 4 Channel Matrix Systems (SQ, QS, RM)

2000 E/III	5-35,000	35dB	½ to 1½	turntable or changer	Clear
2000 E/II	6-33,000	35dB	½ to 1½	turntable or changer	Blue
2000 E/I	8-32,000	35dB	¾ to 1½	turntable or changer	Green
2000 E	10-30,000	30dB	1 to 3	changer only	Red
2000	10-28,000	30dB	1 to 3	changer only	Smoke

Plays 2 Channel Stereo and All 4 Channel Matrix Systems (SQ, QS, RM)

RECORD

Continued from page 11

moved away a more mellow sound will result. To record an upright, take off the top and place the mikes above the piano; or remove the front panel and mike the string side of the sounding board, as you would with a grand. Again, vary the mike distance to obtain the right balance of brilliance and mellowness. Or you could forget the mikes entirely and use a Helpinstill electromagnetic pickup on the strings.

Flute. Locate the mike close, at the blank area between the mouthpiece and the first finger holes. Avoid placing the mike directly in front of the mouthpiece, else the player will blow wind into the mike.

Clarinet. Adjust the height of the mike to place it level with the finger holes (not down at the bell), and adjust the mike distance to get a rich sound without too much fingering action noise.

Saxophone. As with the clarinet, set the mike level with the finger holes, just above the bell.

Harmonica. Bring the mike close to get a rich, detailed sound; use a foam windscreen on the mike to minimize the pickup of breath noise.

Brass. Use a somewhat greater distance (12-18 inches), and try placing the mike slightly to one side rather than directly in line with the bell, in order to remove the biting edge from the sound.

Acoustic guitar, lute, mandolin. Place the mike directly in front of the sound hole, just far away enough to give the player freedom of motion.

Electric guitar and electric bass. Here you face a fundamental choice. You can record the electrical signal itself, yielding a very clean and dry sound (which you might juice up with artificial reverb later). Or to get a more familiar sound, place a mike in front of the guitar amp; of course, the resulting sound reflects the qualities of the guitar amp's speaker, for better or for worse. If the amp has a single full-range speaker unit, place the mike in front of the center of the cone. If it is a two-way system with a cone driver for lows and a horn driver for highs, put the mike in front of the horn. (If the grille does not come off to let you view the speakers, press the lens of a flashlight against the grille to illuminate the drivers within.)

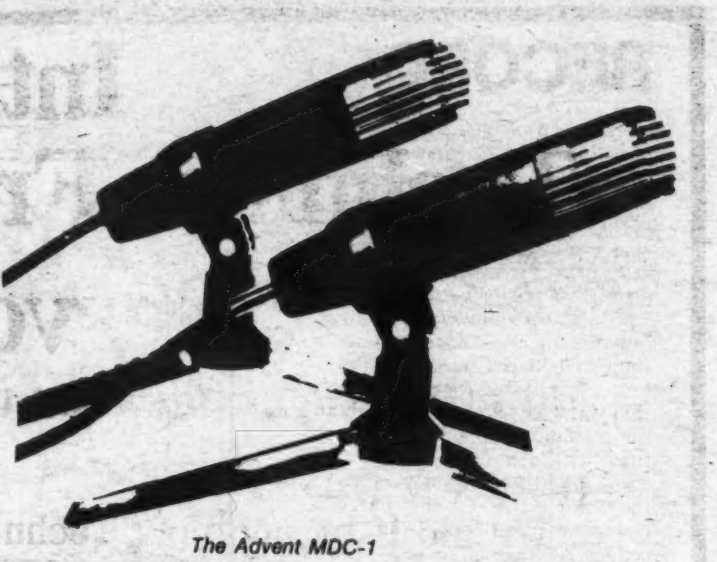
Drums. Two or three mikes may be required to cover a full drum set, and experimentation is advisable. Often a good mike position is one in line with the drumhead surface, just beyond the edge of the drum so that the mike won't be struck by the drumstick.

Incidentally, if you don't have a drum set you can still lay down a pretty good percussion track on tape by experimenting with household utensils. Try wire brushes on a metal pot top for instance. To make a bass drum sound, tap the body of a cardioid mike with a finger.

As you do experimental recording with your mikes, one of the things you will learn is how to correlate recording meter levels with the taped sound. With some sounds, such as a clarinet legato, you can record up to a level of 0 VU or higher, without distortion. But with transient sounds (percussion, guitar, piano) you probably will have to keep your maximum meter levels at —5 VU or lower in order to avoid a muffled sound due to tape saturation.

Equipping Yourself

Once you have mastered mike technique by making some simple mono recordings on one channel of a cassette or open-reel recorder, you can settle down to some serious recording. With a pair of mikes and a stereo recorder you can record any one instrument with ease, and perhaps two instruments or an instrument with a vocal. Indeed, if you juggle the positions of players to get two instruments on each mike, you could tape a four-piece ensemble. But what if you want to do something more complex — a six-piece combo plus vocals, or a combo consisting of piano, drums and flute (which takes five mikes, two each for piano and drums plus one for flute)? You need more equipment, and the approach you take to recording will determine what equipment you should buy. (Don't let the opposite happen; if you buy equipment and let it dictate the ways in which you can record, you may never get the musically satisfying result you want.)



The Advent MDC-1

The two approaches are: 1) to perform the various vocal and/or instrumental tracks of a song *simultaneously*, getting it all on tape at one time; or 2) to perform and record the tracks *sequentially*, mixing them together later.

Mixing It

In the all-at-once approach, the recording is essentially a document of a performance. Use a conventional stereo recorder (either your present one or a new one), and equip yourself with many microphones and a multi-input mixer. You will need approximately as many mikes as the number of instrumental and vocal parts in the arrangement. In principle you provide each instrument and voice with its own mike, and the mixer will permit you to combine all of the sounds into a finished two-channel stereo recording. If your group really has its act together musically, if your music is all composed and fully rehearsed and you want to get the performance down on tape, this is the way to go. Of course you have got to be sure that you really are ready to go; if somebody goofs you'll have to start over again. Once the sound is mixed you can't take it apart again to fix one bad part. Usually you will need several run-throughs just to get the mike positions and mixer balances right; then you can do some real "takes."

In choosing a mixer, consider whether it has the features you need and whether it is compatible with your mikes. Taking the latter question first, if you are using professional low-impedance balanced-line mikes, you may want a mixer whose inputs are balanced and low-Z to save you the extra cost of line transformers. As for features, some of the useful ones are as follows. A *panpot* permits the sound of a mike to be placed anywhere in the stereo image — left, right, center, or in-between; it is commonly used to place a soloist at center stage in the recording, though you could use a panpot to make a sound move continuously back and forth. *Low-cut filters* are useful to clean up a muddy-sounding vocal, compensate for proximity boost, or eliminate low-frequency noise due to hum, floor vibration or mike handling. *High-level* (auxiliary) inputs permit mixing in the output of another tape recorder or other signal source as well as mixing mike inputs. *Attenuators* at the mike inputs can help to prevent mike preamp overload on very loud sounds.

Perhaps the most widely used professional stereo mike mixer is the Shure M688 ($130), which has four low-impedance balanced inputs (one of them panpotted) and an auxiliary input. Somewhat more flexible is the Pioneer MA-62 ($250), providing six mike inputs with attenuators and low-cut filters; two inputs are pan-potted and four are switchable for either mike or high-level input. But the mike inputs are unbalanced high-impedance types, requiring line transformers for use with professional mikes. The Teac Model Two ($300) is similar in design and features to the Pioneer. The Tapco 6200 mixer ($350) provides balanced low-impedance mike inputs, each with attenuators and both low and high-frequency tone controls; each input is pan-potted and can also be switched to accept high-level inputs. If you are handy with a soldering iron, there are a couple of good kit mixers on the market. The Heathkit TM-1626 ($150) has four mike inputs (one panpotted and all switchable for either balanced low-Z or unbalanced high-Z) plus two high-level inputs. And the Gately Pro-Kit ($300) provides six balanced low-impedance inputs, pan-potting, auxiliary inputs and high-quality circuitry. Incidentally, if you plan to use Dolby-B noise-reduction, the Advent 100A ($300) can be combined with Advent MPR-1 mike preamps ($35 each) to operate as a balanced low-impedance four-input mixer having very low noise (but limited flexibility); it continues to provide Dolby encoding and decoding, of course.

If you decide that you need a better recorder than the basic cassette or quartertrack deck that you probably started with, you might consider getting a stereo machine whose tapes will be directly compatible with machines used in studios and radio stations. This format is "two-track" stereo; machines in this format usually can operate at 15 ips as well as 7½ ips and will accept 10½-inch reels in addition to the ordinary 7-inch reels. The ReVox A77 machines ($960) are probably the most widely used of this type. Two-track machines are also available from several other manufacturers; perhaps the most notable are the new Pioneer RT-1050 ($700) and the Teac 3300S-2T ($750). The Pioneer offers attractive flexibility, including an accessory plug-in quarter-track head assembly for compatibility with ordinary consumer-grade machines.

Multi-Tracking It

The above approach, using many mikes simultaneously with

Continued on page 14

Introducing Technics' Frequency Generator Servo Turntables

No other turntables for under $150 surpass their performance.

HOW WE DID IT

We did it by applying Technics technology to a new type of belt-drive system. By using a frequency generator servo-controlled DC motor with highly reliable IC circuits that most manufacturers save for their expensive turntables.

SPECIFICATIONS	SL-20 MANUAL	SL-23 SEMI-AUTOMATIC
Wow and flutter (WRMS)	.05%	.05%
Rumble (DIN B)	-65dB	-65dB
Power Consumption	2 watts	3 watts
Suggested Retail Price	$99.95	$139.95

We did it by adding electronic speed switching instead of mechanical switching. That means no stretched belts for greater reliability. There's also a servo amplifier that electronically locks the motor into the correct speed. So fluctuations in AC line voltage frequency won't affect turntable speed.

THE RESULTS

The results. The kind of outstanding specs you expect from Technics. Like rumble, wow and flutter figures so low they're inaudible. Like extremely low power consumption. So there's less heat and less deterioration of internal lubrication which means longer motor life.

For precision tracking, both the SL-20 and SL-23 come with a statically balanced "S" shaped tone arm. One anti-skating adjustment for all types of styli. And viscous damped cueing.

AND THERE'S MORE

Like 6% variable pitch controls. CD-4 phono cables. An integral base with simulated metal finish. A hinged detachable dust cover. And, in the SL-23 there's a built-in stroboscope and automatic return.

The Technics frequency generator servo turntables. The concept is simple. The execution is precise. The performance is outstanding. The name is Technics.

Technics
by Panasonic

One Panasonic Way, Secaucus, N.J. 07094

MODEL SL-23
$139.95

MODEL SL-20
$99.95

See Your Local **Technics** *dealer:*

TECH HIFI
All Stores

OLDE COLONY STEREO
Quincy & Hanover

FRED LOCKE STEREO
All Stores

LAFAYETTE RADIO
Springfield

STEREO PLACES
N. Prov. & Warwick, R.I.

LECHMERE
All Stores

NANTUCKET SOUND
All Stores

BODEX
Marlboro

BI-RITE
All Stores

IMPULSE INC.
All Stores

K&L SOUND
Watertown

FITCHBURG MUSIC
Fitchburg

NEW ENGLAND MUSIC
All Stores

LaCHANCE
Gardner

DeORSEY RECORD
All Stores

How will you choose your next Stereo Receiver, Amplifier or Tuner?

? **From Manufacturers "Specs"?** They all seem pretty good, but how do you know the "specs" are honest? And which "specs" are most important? What about things that aren't specified?

? **From Magazine Reviews?** How reliable and unbiased are they? Have you *ever* seen a bad review? And remember that the magazines generally get special "review samples" which are carefully adjusted for best performance.

? **From advertisements?** Have you ever seen a manufacturer say his product wasn't the A-1 Hot-Shot Mostest Best?

? **On Salesmen's Advice?** If you go to five different stores, you'll probably get at least three different stories. Did you ever notice that what Store A recommends, Store B condemns as absolutely worthless? Who do you believe?

? **On reputation?** How do you know the best receiver of 1974 is the best receiver of 1976?

? **On friends advice?** True, they probably have your best interests at heart, but where did they get their information? (probably from "spec" sheets, reviews, advertisements, salesmen and other friends!)

We know you want to buy the best stereo receiver amplifier or tuner you can afford, and we want to help you make a rational logical decision. That's why we are constantly testing and evaluating the products of different manufacturers on the most modern, expensive testing equipment available. On the basis of these tests we choose the two or three best units available and offer them for sale. And we compile the test results in a notebook so that you, the customer, can compare the results and see why we recommend what we recommend. We want to give you hard objective facts, not hype and folklore.

So if you need a guide through the electronics jungle, come to Suffolk Audio. Ask us some questions. You'll find we're concerned with your welfare, both before and after the sale. Suffolk Audio measures up to your trust.

SUFFOLK AUDIO

1105 Mass Ave Cambridge, Mass. 617-868-1080

RECORD

Continued from page 12

a mixer to record a two-channel stereo tape, is fine if you have your performance in finished form ready to put down on tape. But sooner or later you may find that you need a more flexible approach, one which is becoming increasingly widespead — namely the use of a multi-track recorder as a creative composing and orchestrating tool. Instead of combining ten channels of sound all at once into a tape, you lay down the tracks *successively*, one or two at a time, experimenting and re-recording each track as the spirit moves you, and then mixing it together with previously recorded tracks only when you are satisfied with them. With this approach you can play duets with yourself, overdub a trio until it becomes a chorus, tape the instrumental parts now and the vocals later or vice-versa — let your imagination run.

In a large studio this is done with the aid of a 24-channel recorder. But it can be done at home as well, thanks to the advent of four-channel tape decks having special "self-synchronizing" facilities. Also called Simul-Sync and Multi-sync, this involves using the recording heads in some channels as playback heads while simultaneously recording on other channels.

You use it like this. On channel one of the four-channel tape you lay down a basic rhythm track. Then rewind the tape, put on headphones, and while listening to track one you record the lead guitar on track two, perfectly synchronized with the rhythm track. Then listen to these on headphones while recording a flute part on track three. (If you make a mistake you can back up and record the flute over again on track three without disturbing tracks one and two.) Then, when you have three tracks that you like, you use a mixer to combine them and store the result on track four. If you don't like the result you can erase track four (only) and re-do the mixdown until you get just the right balance of the three tracks. When you are satisfied with the mix, erase tracks one to three and record fresh material on them — piano and vocals perhaps (in each case listening to track four to synchronize the new tracks properly). When you are satisfied with these you can make a final mixdown of everything into a two-channel stereo recording by feeding the output of your mixer into an ordinary two-channel stereo recorder.

This gradual buildup of a quite sophisticated recording is made possible by the self-synchronizing feature. If you tried to do the same thing with a conventional recorder you would find later tracks lagging behind earlier ones because the tape arrives at the playback head a fraction of a second later after it passes the recording head.

The best-known multi-track machine with self-sync is the Teac 3340S ($1200). Others are available at higher cost, and two at lower cost: the Dokorder 7140 ($630) and 8140 ($750), but sales and service for these machines are less widely available than for the Teac.

One thing that becomes especially important in multi-tracking is noise. Each time you copy the signal from one track to another, the tape hiss goes up three dB; so if you do it two or three times you can end up with a rather noisy tape. So a good noise-reduction system is a valuable accessory. Either Dolby-B or DBX may be used. A two-channel Dolby by Advent or Teac will cost $100-$150. A two-channel DBX 117 ($175) provides about the same amount of noise reduction as a Dolby-B and also serves as a general-purpose compressor/expander. The two-channel DBX 122 ($260) will provide larger amounts of noise reduction if desired. To process more than two channels at a time, you can use two two-channel units, or consider the Advent 100A ($300) or the DBX 150 series of four-channel units.

Processing the Sound

Finally, you may want to do some processing of your basic sound after it comes out of the mikes. One of the handiest tools for the recordist is an equalizer, which is basically a flexible multi-band tone control. Real microphones don't have perfect frequency response, and even if they did you might prefer a bright sound for some instruments and a mellow response for others. An equalizer can give you this choice while also permitting you to fix problems. Boosting response around 3000 Hz will bring a solo voice "forward" and apparently improve articulation. Boosting around 10,000 Hz will add crispness to cymbal sound, and reducing response in the 5000-to-10,000 Hz range will take some of the edge off badly recorded horn sound. Rolling off response below 150 Hz can reduce hum, clean up muddy vocals and compensate for proximity boost. There are many equalizers on the market; the BSR FEW-2 five-band unit ($100) is flexible enough for most purposes.

The other process used to glamorize studio recordings is the addition of reverberation, which gives the sound a lively, spacious quality. There are several ways to accomplish this. One is to connect a patch cord from the output of a three-head recorder back to its auxiliary input or back to an input of a mixer connected to the recorder. Start recording and adjust the level of the feedback signal to achieve an attractive echo effect (too high a level will produce a howl). This process is more natural-sounding at 15 ips than at 7½ ips. Another approach is to use your bathroom as a reverb chamber; set up a good loudspeaker and a mike and mix the resulting sound into the recording. Finally, of course, you can use a reverb amp such as the Pioneer 202 ($140) or the Lafayette No. 13R66673 ($60).

For More Information

The best basic guide to microphones is "A Microphone Primer" by Jim Long, published in the Dec. 1972 to February 1973 issues of *Audio* magazine. Reprints probably can be obtained from Electro-Voice (600 Cecil St., Buchanan, Mich. 49107) for 50 cents or so.

The complete modern textbook of studio recording techniques is *Modern Recording Techniques* by Robert Runstein, published by Howard Sams Co. for $13.

A thorough course in studio recording, including instruction in mike technique and multi-track methods, is being given at the Intermedia Sound studio, 331 Newbury St. Phone 267-6095. Some instruction in studio recording methods is also given at Berklee College of Music, 150 Massachusetts Ave., Boston; contact the instructor, Joseph Hofstedder.

Musician's Guide, a local magazine published by the N.E. Musician's Guild (739 Boylston St., Boston 02116), has useful articles; note for example "The Four-Track Home Studio" in the August 1975 issue.

Finally, Teac has produced an entertaining and encouraging demo record called "Home Made with Teac" which promotes their Model 3340S but gives some good pointers on multi-track home recording as well. If you try hard enough you can get it through a Teac dealer. While you're at it, inquire about "Sessions," a promotional demo record produced by JBL.

eardrum

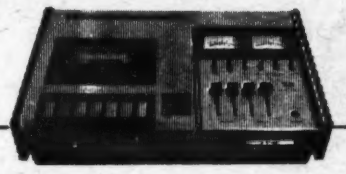
GRAND CLOSING SALE!

March 8-13

Eardrum is closing its Kenmore Square store on March 13th. While they are sentimental about closing their original store it means unprecedented savings for you! Eardrum is practically giving away its stock of demonstrator and used equipment.

$5 OFF PER DAY!

For every day these units last (quantities noted below) take an additional 5 dollars off the sale prices.



TAPE DECKS

1 Crown SX 822	700 used
1 Teac A2300s	399
1 Sony TC377	299
1 Teac A400	239
1 Teac A170	189
1 Kenwood KX710	189
1 Superscope CD302A	125
1 Revox A77 1104 MKIII	499

TURNTABLES

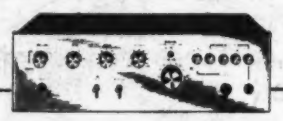
1 Glenburn 2155A	45
1 PE 3044	75
1 Dual 1225	98
1 Philips GA 212	129
1 PE 3048	109
1 PE 3046	89
1 Dual 1249	189

USED GEAR

1 Sony 6045	129
1 Pioneer PL15D	85
1 PE 3060	109
1 PE 3012	60
1 Superscope CD 302A	115
1 KLH 38	69 pr.
1 Marantz 250	329
1 Harman Kardon 330B	129

RECEIVERS

1 Rotel RX150A	90
1 Kenwood KR1400	125
1 Sansui 331	139
1 Sansui 881	359
1 Sansui 771	289
1 Sansui 8080	449
1 Kenwood KR5400	259
1 Kenwood KR3400	179
1 Kenwood KR9400	519
1 Kenwood KR4400	209
1 Pioneer SX-737	275
1 Pioneer SX-535	199
1 Pioneer SX-434	169

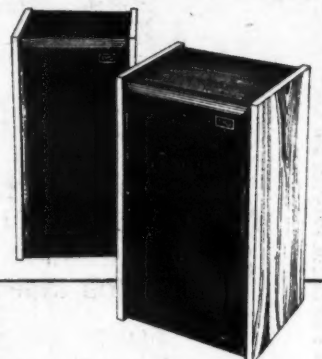


AMPLIFIERS

1 Kenwood KA4006	175
1 Sansui AU4400	139
1 Kenwood KA6006	245
1 Pioneer SA9900	519

CAR UNITS

1 Pioneer TP7000	119
1 Pioneer TP232	36
1 Pioneer TP200	73
1 Pioneer KP300	95
2 Jensen 5¼ 20 oz.	20 pr.
2 Jensen 5¼ Dynamount	25 pr.
2 Jensen 6x9 Co Ax 20 oz.	33 pr.
2 Pioneer P10L	12 pr.
2 Pioneer TS 160	20 pr.
2 Pioneer TS 163	10 pr.



SPEAKERS

4 Avid 60	45 ea.
2 Marantz 4g	39 ea.
2 Advent 2	39 ea.
2 Ess Amt 1	199 ea.
2 EPI 201	129 ea.
2 EPI 90	59 ea.
2 Infinity POSII	89 ea.
2 Avid 100	69 ea.
2 Advent Smaller	79 ea.
2 ADS L-400	79 ea.
2 EPI 400	225 ea.
2 Epicure 400+	249 ea.
2 ADS L500	115 ea.
2 ADS L710	189 ea.
2 ADS L810	249 ea.
2 Advent Walnut	89 ea.
2 Avid 102	99 ea.
2 Avid 103	129 ea.
2 Avid 105	229 ea.
2 Avid 102	89 ea. used
4 ESS Amt 5	109 ea. used
2 B+O 4703	139 ea.
2 B+O 2702	69 ea.
2 Marantz 6g	99 ea.
2 McIntosh ML10C	175 ea.

ESOTERICA

1 Crown DC300A	
1 Crown OC 150	
1 Crown IC 150	
1 Crown D-150A	
1 SAE MKIB	665
1 Spectro Acoustics P101	200
1 Spectro Acoustics P202	229
1 GAS Ampzilla	629

*All units are demonstrators unless otherwise noted
*All units subject to prior sale
*Original warranties and packing available on request
*All sales final

Look for Eardrum's newest store opening this Spring!

eardrum

Kenmore Square only
468 Commonwealth ave
261-1155
mon-fri 10–9 sat 10–6

ACCESSORIES: A FEAST FOR SORE EARS

Of equalizers, headphones, cartridges and Dolbys

Jon McIntosh

by William A. Kanner

Let's assume you've got an adequate-to-good stereo rig. You've got a receiver (or separate amp, preamp and tuner); you've got a good turntable; you've got the best speakers you can afford; you've even got a pretty good tape deck. What's a little something that would be an appreciated birthday or graduation gift? Or the kind of gift you give yourself?

The answers to those questions are almost as diverse as the people who ask them. The audio market is a collector's paradise of useful and next-to-useless accessories and gadgets. These devices come in prices ranging from a couple of bucks to over a hundred and can satisfy almost any audio whim. The easiest way to browse through this potpourri of audio paraphernalia is by category.

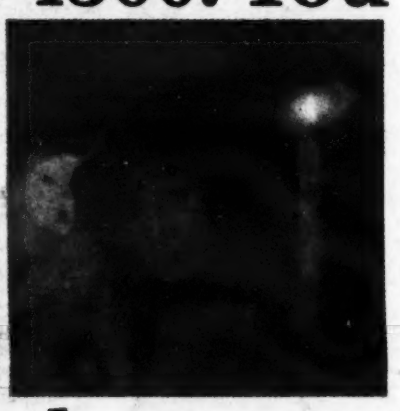
You might want to consider a new set of headphones. Headphones are not only a way to listen to music at much greater volume than your friends, neighbors or landlord might permit, phones are an ideal way to concentrate on certain kinds of music. The intensity of the music, subtlety of the engineering and full stereo illusion can best be perceived through headphones. Phones provide a direct coupling of transducer to ear; there are no room acoustics to get in the way.

There are a number of kinds to select from. The first decision you'll have to make is whether you want the isolating or the so-called "open-air" models. The isolating type tend to be heavier. Their cups fit snugly and "seal" the ear or head with soft foam or liquid-filled pads. The isolating headphone truly removes the listener from his immediate environment and can transport him to a world where only the music exists. While this may be a tremendous sensual ex-

Continued on page 18

You make a tape with time and thought. Carefully chosen selections recorded in the sequence that most pleases you. The musical coherence and perception is yours, a personal expression. And when the time is right to share

that experience with someone you care for, having to stop and turn the tape over can break the mood you worked to create. Interruptions like that don't happen with the A-4300. You can enjoy continuous music on both sides of a tape with the automatic reverse function. And with automatic repeat, a favorite tape will play as long as you like. Whether you want the music up front or in the background, the A-4300 can give you solid music for the better part of an evening.



Check out the A-4300, and listen to it for as long as you like. Just call (800) 447-4700* for the name of your nearest TEAC retailer. In Illinois, call (800) 322-4400.

TEAC.

The leader. Always has been.

TEAC Corporation of America
7733 Telegraph Road
Montebello, Ca. 90640
©TEAC 1975

when you don't want the music to stop

TEAC A-4300

FEAST

Continued from page 16

perience, it's a problem if you want to hear the doorbell or a baby crying.

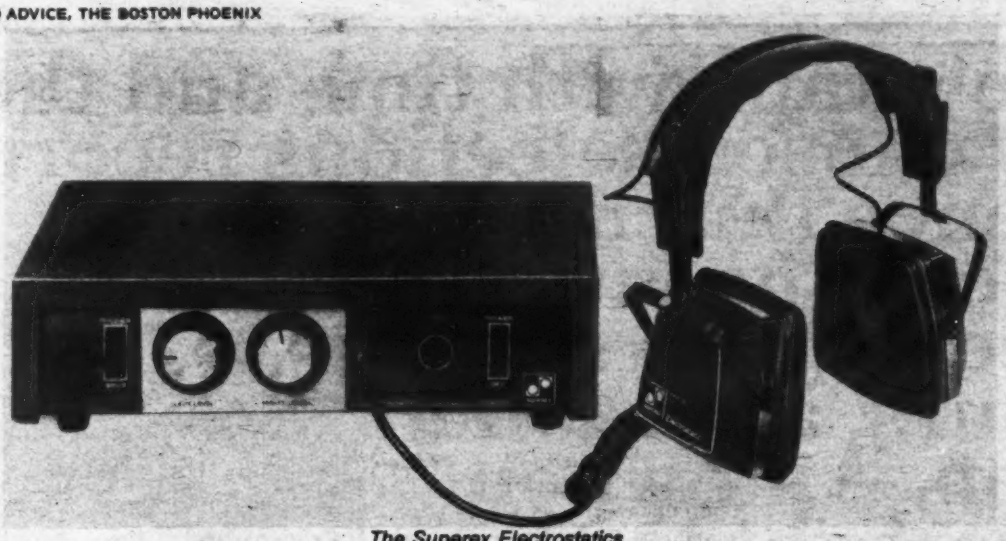
For the latter the on-the-ear type of headphone should be tried. These are generally lighter, fit somewhat more loosely *on* the ear rather than around it, and will be less tiring. Good 'phones come in both varieties.

Of the non-isolating type, some worth an extended try-out include the Pioneer SE-700, Sennheiser's HD-424, and Pickering's OA-3. The Pioneer unit is a very light 13 ounces when you consider the solid sound it puts out. The newly designed high-polymer driver and piezoelectric effect combine to create an almost transparent sound. The high polymer aluminum-coated film expands and contracts almost as effortlessly as electrostatic drivers. The result is a light but solid, natural sound. The SE-700 sells for $80.

Sennheiser, which created the big interest in these open-sounding 'phones a few years ago with their HD-414, now has a model 424. Its 6½ ounces make it a little heavier than the 414 and the $75 price is $30 more, but its appearance has changed and (Sennheiser says) the frequencies at both ends are more defined. Combine that with greater comfort and you've got a phone worth checking. In fact, both the 414 and the 424 are worth a listen and comparison.

Pickering's OA-3, at $40, weighs 7½ ounces. It is a standard on-the-ear type with respectable sound and a light and airy feeling.

There are a number of interesting models of the fully isolating type. Superex's PEP81 is an electrostatic system. Conventional speaker and headphone systems use cone drivers while elctrostatics operate under a principle involving two thin plates separated by electrostatically charged ions. As the charge of these ions varies (with the output voltage from the amplifier), the plates move, causing the production of sound waves. The value of electrostatics is that they give a remarkably clear sound and reproduce transients accurately.



The Superex Electrostatics

The PEP-81 is the latest of several generations of Superex headphones. It is a light (8½ ounces) model which requires an "energizer" to keep the ions charged. The energizer can be either plugged into an AC outlet or used as a self-energized system. Less distortion and more uniform dynamic output are provided by AC operation. The sound is rich and sharp. Detail remains clear and distinct and unusual for some electrostatic systems (speakers as well as headphones) — bass response is solid. These headphones are not inexpensive. The complete PEP-81 system sells for $150 but the energizer will handle two sets of 'phones. An additional pair will run you another $78.

A more conventional and less expensive isolating headphone is the Koss Phase 2 — more conventional only in the sense that the Phase 2 uses conventional cone drivers. However, it also has an unusual design feature, a sort of stereo enhancer. The Phase 2 phones allow you to play with the sound to suit your own tastes; you can become (in a limited way) the recording engineer. Koss Phase 2 sells for $75.

Another set of headphones that lets you play with the sound is AKG's 180. By twisting a knob on each cup, you can change the driver's distance from the ear, producing a different mass of air moved by the driver's excursion. This, in turn, alters the sound produced, since it occurs within a closed system. There is one drawback with the AKG 180s: they have an impedance of 600 ohms, which means that when they are used through a conventional headphone jack they are limited to a rather low volume. The AKG 180 has a suggested price of $70.

Working backwards through the system from the headphones, we arrive at the equalizer. This fits between your amplifier and your speakers or phones and changes the sound. You say your tone controls do that? True, but grossly. Standard bass and treble controls — even with a midrange control and all of them independently variable for left and right channels — cannot change tonality as subtly as a good equalizer. The equalizer raises or lowers specific frequency ranges in many more steps than the standard controls. You can cut a 40 Hz range and boost an 80 Hz one. With the standard controls on most amplifiers, you'd either have to raise or lower both ranges. An equalizer can be used to compensate for your room's idiosyncracies or your own to give you precisely the sound you want. It can also compensate for anomalies on the original recording or allow you to make adjustments in your taping of a given program. In short, an equalizer gives you much more control over the material than you had before.

For the economy-minded and the handy, the Ace Equalizer AE2002 at $84.25 for the kit ($133.75 wired) is a good buy. It's a five-band, 10-octave unit with each band covering two octaves. The Ace has separate controls for each channel.

A more sophisticated equalizer naturally will cost you more money. Most of these go for $200 and up.

ADC's new 500 operates in 12 ranges from 30 Hz to 16,000 Hz. Each slider has a range of plus or minus 12 dB. The unit also has an equalize record switch and two meters to compare the outputs of the two channels. The meters can also be used in conjunction with the ADC test record to measure the response of the system, from the cartridge to the equalizer input. The ADC 500 carries a price tag of $300.

JVC has a five-step equalizer that will feed an equalized signal into your tape deck. The SEA (Sound Effect Amplifier) 10 varies frequency ranges around its five selected frequencies (from 40 to 15,000 Hz) by plus or minus 12 dB. Both channels are altered simultaneously. The SEA 10 sells for $130.

Coming up the price scale is SAE's new Mark XVII at $300. Each channel can be altered independently with the XVII's 10 controls per channel. It, too, has a frequency range of 40 to 15,000 Hz, but, unlike most other equalizing units, the SAE Mark XVII will alter the range by plus or minus 8 dB *or* plus or minus 16 dB at the touch of a switch. This means you can make major or subtle adjustments easily. The 10 frequency ranges are in octave steps over the entire range.

Another useful device you might want to insert in your apparatus is a noise-reduction unit. The best known are the various Dolby system products made by Advent and Teac

Continued on page 22

A Fresh Approach To Sound Reproduction

Ambient presents the SR Series Loudspeakers consisting of four models Each a superb performer in its category combining high Power handling capability, sonic purity in tonal balance and precise pin point localization.

Ambient Inc. is a totally new concept with a fresh new approach to loudspeaker design.

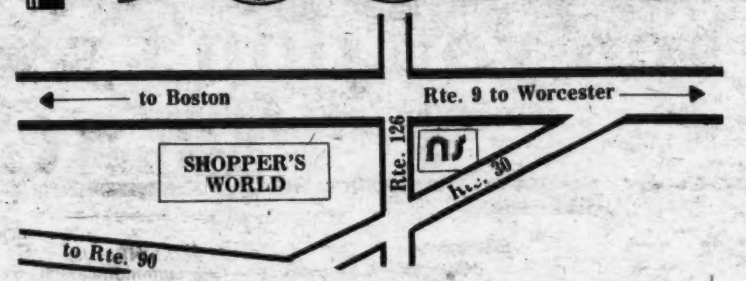
For additional information and for information about the location of the Ambient dealer nearest you write

Ambient
P.O. Box 65
S. Easton, Mass. 02375

Our customers know we're the best.

You can know it too. — Finally there is a dealer in the Boston area dedicated to bringing you the very best in audio reproduction equipment and service. We offer truly musical components in every price range. Many of our lines have not previously been available in this area. If you are truly striving for accurate sound reproduction, you will find it only at:

natural sound



Located on route 9 west, in Framingham, one mile from Mass. Pike, Rt. 30 exit, (Shopper's World)

401 Worcester Road — Call Collect 879-3556

Savings to make your hibernation more bearable.

Our LR-2200 Receiver with B-I-C Turntable and Two Criterion L-6 Speakers.

System features our LR-2200 stereo FM/AM receiver with 27 watts per channel, minimum RMS, both channels driven at 8 ohms from 20-20,000 Hz; with no more than 0.5% total harmonic distortion. B-I-C 940 belt-drive manual turntable with base and Pickering V15 Micro IV/ATE cartridge, two L-6 3-way 10" acoustic suspension speakers.

Sale $399.95 Save $174.90

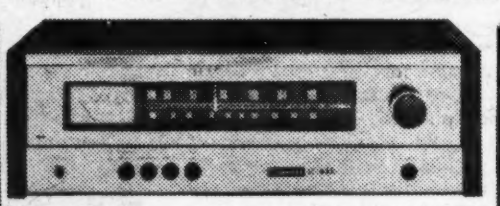
Regular system price $517.37 ate component total $574.85

Our LSC-1209 Stereo FM/AM Phono System.

Compact system features full-size 3-speed record changer, dust cover, inputs and outputs for 8-track, cassette or reel-to-reel tape decks, two air-suspension speaker systems (16¼ x 10½ x 6½" ea.), FM stereo indicator light, auto shut-off after last record and more.

Sale $109.95 Save $10

Reg. $119.95



Our LT-825 Stereo FM/AM Tuner with FM Detector Output.*

Features solid-state circuitry, slide rule tuning, signal strength meter, stereo light, front panel tape outputs, FM mute, MPX filter pushbuttons, more.

Sale $119.95

Reg. $149.95

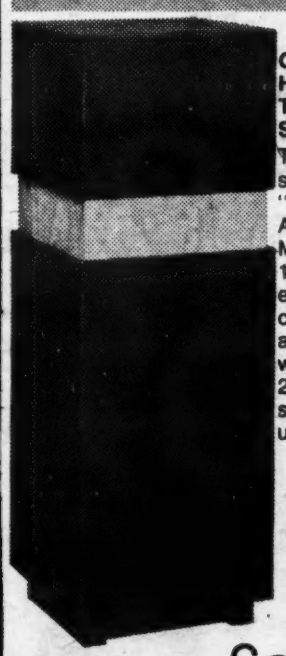
Save $30

3 Ampex 90 Min. Recording Cassettes With Free Stacker.

You get 4½ hours of high quality recording time as well as a free cassette stacker to keep your recordings safe and organized.

$3.99

With Free Stacker



Our Criterion 2005 Heil Air-Motion Transformer® Speaker System.

This fantastic speaker system—features the "Corona Field" Heil Air-Motion Transformer Midrange/Tweeter, a 10" low frequency driver, environmental equalizer control, circuit breaker and more. Handles 300 watt music peaks, 30-24,000 Hz frequency response. Column measures 40 x 13¼ x 12½".

Sale $179.95

Reg. $199.95

Save $20

Our F-800 2½" Transducer Stereo Phones.

Made exclusively for us by Koss, this headset features a fully adjustable headband, sponge ear cushions, 8' cord, ¼" plug and more.

Sale $14.95

Reg. $19.95

Save $5

THE LAFAYETTE HAPPINESS POLICY

If we run out of any sale item, we guarantee you a rain check at the sale price (unless we tell you in advance that the quantity is limited). You can return any item for a full refund within 30 days. You can exchange any item within 60 days.

Sale ends March 10th

Electronically Speaking, Who Knows Better Than

Lafayette

Radio Electronic Shopping Centers

© Lafayette Radio Electronics Corporation 1976

master charge BANKAMERICARD

STORES COAST TO COAST

We reserve the right to limit quantities.

BOSTON
895 Boylston St. (Across from Prudential Center)
Phone 536-1995

BROOKLINE
1048 Commonwealth Ave.
(Opp. Commonwealth Chevrolet)
Phone 267-8900

DANVERS
Endicott Plaza
(139 Endicott St.)
Phone 774-6494

SAUGUS
Saugus Plaza Shopping Center,
Rt. 1 & Walnut St. (Adj. Zayre's)
Phone 233-6710

WEST ROXBURY
1526 VFW Parkway (Rt. 1)
(1 Mile North of Dedham Mall)
Phone 327-0300

NATICK
1400 Worcester St.
(Rt. 9 Opp. Shopper's World)
Phone 875-6146

BURLINGTON
Vinebrook Plaza
(Opp. Burlington Mall)
Phone 273-1785

PROVIDENCE, R.I.
1224 No. Main St.
(South of Sears)
Phone 521-4444

WARWICK, R.I.
943 Bald Hill Rd.
(½ mi. South of Warwick/Midland Malls)
Phone 828-1511

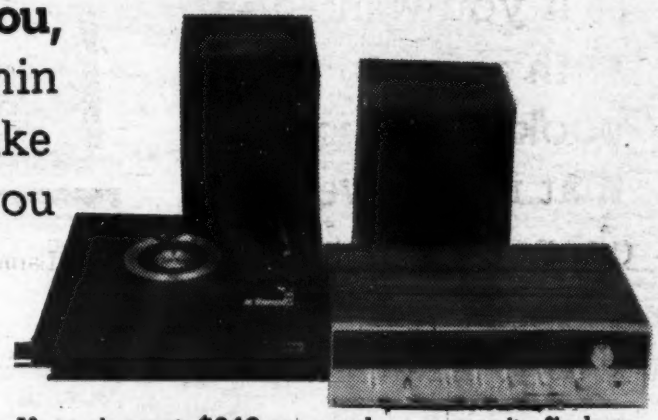
*Imported.

MOST STORES OPEN LATE MOST EVENINGS

HI-
RISK-

Buying a music system at Tech Hifi is fun. Not risky.

For instance, **if anything at all about the system displeases you,** just bring it back within seven days. We'll make things right, or give you back your money.



If you've got $249 to spend, you won't find a better-sounding home music system than this one with the high quality Concord CR-210 am/fm stereo receiver, widerange ADC XT-6 loudspeakers, and a BSR 2260X automatic turntable with a Shure magnetic cartridge. But don't take our word for it, come in to Tech Hifi this week and listen for yourself!

CONCORD BSR **$249**

And when you buy any system or component at Tech Hifi, **you don't risk the possibility of missing out on a better price somewhere else.** Because you get a written guarantee that we'll pay you back the difference between our price and any lower price you may see within thirty days of your purchase. Even if it's some other store's sale price. (Since our everyday prices are so low, this really isn't very risky for us).

And if a component pro we'll either fix it within thr days, or give you a new one We also provide a five-year labor guarantee for recommended loudspeakers, three-year labor guarantee for recommended electronics, and a one-year labor guarantee for recommended turntables and tape decks. All at no extra cost.

One last thought.

Only rarely vide the c quality FM sponse that new Nikko loudspeake Shure magn

NIKKO Ohm BSR

At Tech Hifi, **our salesp fidelity, not high pressure** walk through the door you saulted by a salesman who be ma refrige get he

An do is c how g can so

FREE QUEEN POSTERS

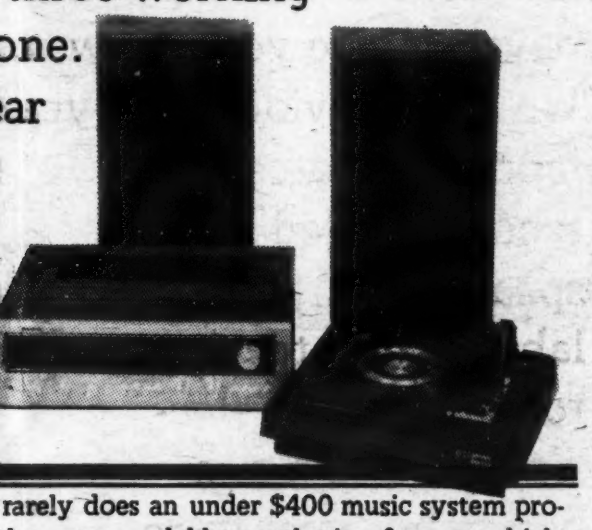
Come in to any of the Tech Hifi locations indicated below (in color) for a giant Queen poster—not available in any store at any price! No purchase is necessary.

240A Newbury St., 870 Commonwealth Ave., **BOSTON** / 38 Boylston St., 182 Massachusetts Ave., **CAMBRIDGE** / Route 9, **FRAMINGHAM** / Route 1, **DEDHAM** 352 Main St., **STONEHAM** / 667 Main St., **WALTHAM** / 279 Main St., **WORCESTER** / 186 Main St., **NORTHAMPTON** / 253 Triangle St., **AMHERST** / Hanover Pl 375 North Montello St., (Route 28) **BROCKTON** / Main St., **HANOVER, N.H.** / Nashua Mall Extension, **NASHUA, N.H.** / Stores also in Rhode Island, Connecticut, New Jersey, Ohio, Pennsylvania and Michigan.

-FI
-FREE

T.M.

proves to be defective,
three working
one.
ear



rarely does an under $400 music system pro-
the commendable synthesis of power, high
y FM performance, and superbly natural re-
e that this $385 Tech Hifi system with the all-
Nikko 3035 am/fm stereo receiver, Ohm E
peakers and a BSR 2260X turntable with a
magnetic cartridge provides.

$385

espeople believe in high
ure. So when you
ou don't risk being as-
no would just as soon
making a living selling
rigerators. You'll
helped, not hassled.

And if all you want to
is drop by to discover
w great recorded music
sound, that's okay too.

We'll put our knowledgeable sales staff and equipped soundrooms at your disposal. Just as if you walked in with an open checkbook. We figure that if we give you a chance to just look around, we'll have a better chance of getting your business if you ever decide to buy a quality music system.

The Larger Advent Loudspeakers included in this exceptional $525 system reproduce all musical sounds with an almost uncanny lack of coloration - especially when combined with the very powerful Cambridge Audio 2500 am/fm stereo receiver! The Philips GA-427 belt-drive turntable with an Audio-technica 90E Dual Magnet cartridge completes the system.

ADVENT Cambridge Audio Philips audio-technica

$525

You don't have to spend money to spend an interesting afternoon or evening at Tech Hifi.

Come in soon. You have nothing to lose.

tech hifi

THE LOWEST PRICE FOR THE HIGHEST FIDELITY.

HAM / 835 Southern Artery, **QUINCY** /
ver Plaza, **HANOVER** /
cticut, Vermont, New York,

FEAST

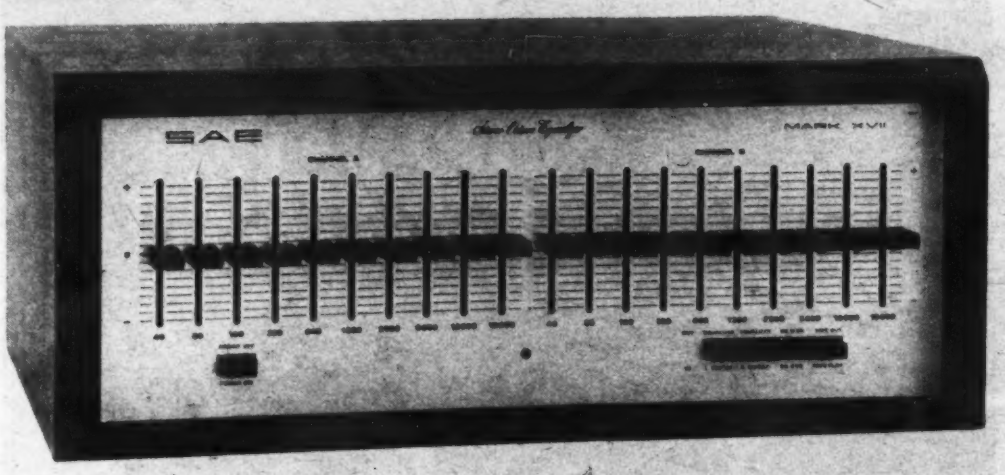
Continued from page 18

among others, but there are more systems available than just the Dolby.

For instance, JVC has what it calls ANRS (Automatic Noise Reduction System). ANRS is entirely compatible with Dolby; Dolbyized tapes can be played through ANRS and *vice versa*. JVC's NR-1020 is an ANRS outboard unit (the company also builds the system into some of their cassette decks), which means that if you have several tape units, you need only make one expenditure. The NR-1020 comes complete with an open-reel and cassette calibration tape and sells for $150.

For those that don't want to hassle with the calibration of a noise-reduction unit, DBX, in Waltham, has one that requires no level matching or pilot tones as the standard Dolby and ANRS systems require. DBX says that the model 122 gives 30 dB of noise reduction and costs $259.

Those are a few of the products that you can get in outboard form and insert into your electronic system. You may find that once you install them you'll wonder how you got along without them.



SAE's MK 17 Stereo Octave Equalizer

Continuing our route through the stereo system, let's take a look at items closer to the source — namely, phonograph cartridges. Most of us bought turntables which included for a nominal charge a "world-famous Bernstein" cartridge. If your Bernstein cartridge is today making the same kind of music as a '47 Chevy, the time has come to replace it. Even if you have a name brand cartridge that's several years old and needs a new stylus, this may be the time to pack the whole thing in and get a new cartridge since the price of a cartridge is not so much higher than that of a replacement stylus. You may improve the sound of your system markedly for a relatively small outlay of cash.

If this is the way you're thinking, think about Ortofon's F15E. While third in their line behind the M15E and VMS 20E, the F15E is a remarkable value at a suggested retail price of $50. Ortofon recommends it as the ideal cartridge for a $500 and under system. The F15E tracks well between one and two grams with a suggested force of 1.5 grams. The F15E, like all Ortofon products, is a crisp and clean cartridge with good articulation and clean transient response. The only things it grants to its more expensive siblings are compliance and a very fine distinction in the upper frequencies.

Stanton has enlarged its line over the past year or so, upgrading the 681 EE to a triple-E and adding a 680 to the line. The penultimate Stanton, the 680EE, complete with a brush that tracks the record in front of the cartridge, is well worth a hearing, too, if you're thinking of making a change in cartridges. It has a suggested price of $62.50.

Shure's V-15 Type III is regarded by many to be the standard of the industry. And at close to $80 it should be *very* good. Shure has now brought out what it claims as "the new number two," the M-95 ED. It has all of the familiar Shure clarity and bass "whomp" and is certainly worth considering no matter what your system cost. The Shure M-95 ED has a suggested price of $60.

Another worthwhile cartridge is ADC's new XLM Mark II. When the first version of this cartridge was introduced a few years ago, it made a big splash as one of the real bargains in the audio field. The XLM Mark II is more expensive, and a fine and smooth cartridge for high-quality sets. It has a tracking force of 1 gram and a suggested price of $100.

Empire, too, has a new cartridge more than worthy of the serious consideration of audiophiles. The 1000 ZE/X, long regarded as an excellent cartridge, is about to be superseded by a new model. Second place in the line is now occupied by the 2000 E/III. Its suggested price is $70.

After cartridges we come to that very important source material, the record. Not even the finest cartridge made will maintain a disc indefinitely. The mere act of playing a record to a minute degree degrades it. Certainly a cartridge with a low tracking force will protect a record from gross forms of record wear. But what about dust?

There are some products on the market that will help you protect your records and give them a longer life. Clearly a brush to collect the dust will help. Even though the Stanton cartridges come with their own brushes, dusting the record off between playings can give you an additional advantage. The simplest brush is the Staticmaster from Nuclear Products. It's a three-inch soft hair brush containing a Polonium element which neutralizes static charges. The brush then wipes away dust and lint. The brush and Polonium element are $12.95; replacement elements are $7.95 each.

Another device for cleaning your records is the Vac-O-Rec. That's right — it does just what you think it does. Put the record on its platter; rotate the unit around the disc; and presto! a vacuum-cleaned record with static-free surfaces results. Vac-O-Rec sells for $34.95.

Another nifty product is Schweizer Design's Hydro-Cleaner. It's a spray and wipe system and costs $9.95.

One of the oldest and most respected cleaning systems is the Watts Dust Bug. This auxiliary arm tracks the record ahead of the actual tonearm and picks clean the grooves with its soft bristled brush, collecting the refuse on a plush pad for removal after play. The plush pad is treated with Watt's anti-static fluid. The Dust Bug kit costs $6.50. Watts makes a variety of record cleaning and care products that can be used by multiple-play as well as single-play turntable owners.

Ball Corporation has just introduced something for new records which is designed to prevent them from getting dirty in the first place. Sound Guard is a lubricant in spray solution designed to be applied to new records. According to Ball, the solution bonds to the record surface but not to itself and provides a protective shield against static and dust for about 20 playings (when the substance should be reapplied). Sound Guard sells for $4.99 in retail stores and $5.99 through the mail.

There's always something you can buy that can increase your pleasure or improve the performance of your equipment. If you think carefully or are as easily tempted as I am, you can find lots of things to add to your stereo system. Getting into audio, you'll learn, is a pursuit without end.

Better Than Any Pusher

No matter how fine the fibers or how soft the "plush" —everything other than the Discwasher system is a pusher.

Pushers only line up dirt and microdust into an even line of contamination. Run your pusher off the record at a tangent— and you spread these particles into a tangent line. And microdust becomes permanently welded into vinyl by a tracking stylus.

Only the Discwasher system has the patented micro-tipped fibers which are directional—slanted—to pick up, hold and thus remove particles from your discs. These same directional fibers also remove fluid and solubilized contaminants by capillary action.

The superior record cleaner— better than any pusher.

DISCWASHER, INC. • 909 UNIVERSITY • COLUMBIA, MO 65201

REALISTIC® SYSTEM

BE REALISTIC ABOUT YOUR MUSIC ...YOU DESERVE THE BEST!

- Realistic STA-90 AM-FM Stereo Receiver with Two Tape Monitors
- Two Realistic Optimus-5B Walnut Veneer Three-Way Acoustic Suspension Speaker Systems
- Realistic LAB-50 Changer with Base and $17.95 Value Elliptical Cartridge

$599

REALISTIC®
for the music-minded

The total harmonic distortion (of the STA-90) was less than 0.025 percent from under 1 watt to 50 watts output, reaching 0.46 percent at 55 watts.

Reprinted by permission of Stereo Review Magazine, March, 1976 Issue.

There's only one place you can find it... **Radio Shack®**

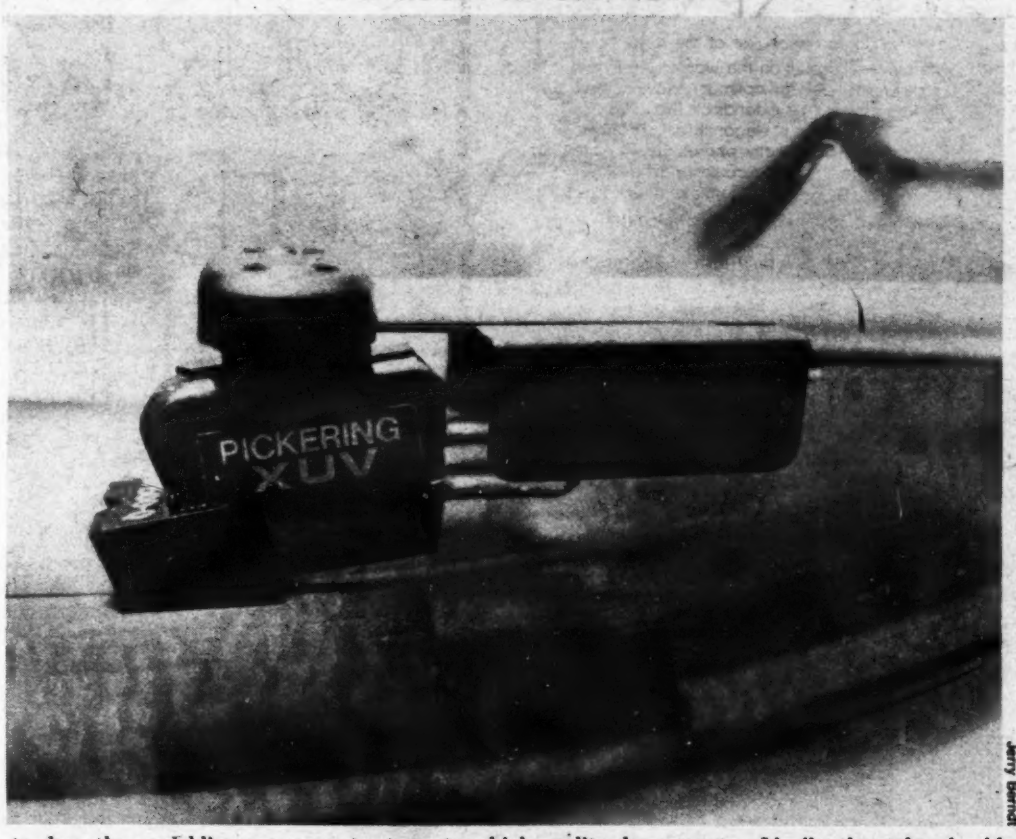
PRESSING MATTERS

All about tonearms

by Michael Riggs

Chances are you've never heard much said about tonearms. They haven't the flash of receivers, all bedecked in mostly useless buttons and lights; their function appears to be simple and altogether prosaic — and it is.

A tonearm is supposed to hold a stylus against the surface of a record at the proper force and attitude and allow it to follow the record grooves. Designing an arm that will do those things is not really difficult; the tough part is getting it not to do anything else. That's what distinguishes a superb arm from a mediocre one: in fact, a second-rate cartridge in a good arm can, and often will, sound better than a top-flight cartridge in a poor one.



Jerry Berndt

How They Work

There are two basic ways of moving a stylus from the outer to the inner grooves of a disc. Each way has its own set of advantages and drawbacks. The pivoted arm, found on almost all turntables in use today, embodies the more familiar of the two designs. In its most primitive form, this design requires just a straight balanced beam supported by bearings, with a cartridge attached to one end. The most obvious problem with this arrangement is friction. Unless the bearings permit the arm to move effortlessly, the stylus and record will be damaged as they try to drag the unyielding arm across the record and over warps. The best arms have less than 20 mg. of friction, vertically or horizontally. Given the current state of the art, you won't (or shouldn't) run into gross difficulties with friction unless you try to mate a high-quality, low-tracking-force cartridge with a cheap arm. Nonetheless, it remains desirable to keep friction low to prevent accelerated record and stylus wear.

Another problem with pivoted arms stems from their geometry. Ideally, the stylus should be tangential to the groove at all times. In practice, the best a properly designed and adjusted, conventional pivoted arm can manage is to be exactly tangent at two points on the record surface. At all other positions, some distortion will result from the unavoidable stylus misalignment. Fortunately, the amount of tracking error, and therefore the amount of distortion, will be small if the arm is correctly designed and the cartridge is properly positioned in the headshell.

Garrard, on their top-line turntables, deal with the tracking error problem by eliminating it. Their arms are built so that the headshell turns slightly as it traverses a record, maintaining near perfect tangency throughout its travel. The principal disadvantages of this approach are that it adds mass to the arm and requires more bearings and moving parts, which tend to cause higher, though not necessarily excessive, friction. Also this design fails to eliminate skating.

Skating is the tendency of an arm to pull toward the center of a disc, causing unequal pressures against the two walls of the groove. It happens when the disc pulls on the stylus in a direction different from the stylus-to-pivot axis. Unless a correcting force is applied, only higher tracking forces will prevent distortion, and styli and records will wear unevenly and more quickly than they otherwise might. Almost all modern arms incorporate some kind of anti-skating adjustment. Still, the best that can be achieved with a pivoted arm is a compromise. Instantaneous

Continued on page 26

CLEAN-SWEEP RECORD CARE

INNOVATIONS IN RECORD CARE THAT MEAN PROFESSIONAL CARE

CLEAN-SWEEP RECORD PURIFIER

Over 20,000 cleaning bristles per square inch to effectively remove even the finest particles of lint, dust and dirt from record grooves.

CLEAN-SWEEP TOTAL SYSTEM

The total maintenance system for complete record and stylus care. Includes anti-static indicator bar that will actually change color with degree of ionization.

CLEAN-SWEEP STYLUS CARE

A dual head brush to scrub and buff stylus gently and thoroughly to allow proper tracking and reduce stylus wear.

CLEAN-SWEEP RECORD CLEANING FLUID

Specially formulated non-residue forming cleaner designed to be used with all Clean-Sweep care products.

Mfg. in U.S.A. by

HORIAN ENTERPRISES
12381 SCHAEFER
DETROIT, MICH. 48227

stereos turntables

Gyro Gearloose

- finest audio servicing in Boston
- prompt, professional analysis & repair
- servicing is our only business

Call or stop by

Gyro Gearloose

1302B Comm. Ave.
Allston
731-9629

tape recorders tv's

INVISIBLE SOUND, COMPACT AND POWERFUL.

The ADS L710 and L810 are four driver, three way speakers for audiophiles who demand studio performance from a system that is still compact enough for bookshelf placement. These systems share exceptionally wide-range frequency and power response that places them in the small select group of reference quality speakers without demanding the usual penalty of size and price.

We invite you to test them against any high quality speakers regardless of cost. Listen how accurately the virtually massless 1" soft-dome tweeter follows every detail of a solo violin. Notice how uniformly the unique mid-range driver reproduces the subtleties of a familiar voice – no brassy sound ever; instead, unmuffled openness. The 2" soft dome smoothly radiates nine times as much power into a hemisphere as a conventional speaker of the same area.

Then train your ears on the woofers. They are small in diameter for optimum transient and power response; this extends clarity and detail down into bass. It is elegantly accomplished by two active, perfectly phased drivers with unprecedented lateral excursion. You never before heard a bass drum come so much alive.

Flawless consistency in all these qualities is our uncompromising standard of excellence, and it is built into every model from ADS.

Your local ADS dealer will proudly demonstrate the L710 and L810 in his sound studio. Take the time and test them critically. Take the step beyond transparency: Experience "Invisible Sound." It then will be impossible for you to accept anything less.

Analog & Digital Systems, 64 Industrial Way, Wilmington, Massachusetts 01887. 710C-76 ISL

ADS L710

ADS L810

THE MAGNIFICIENT SEVEN

There's only one Hi-Fi store that gives you the lowest prices, and seven name brand turntables to chose from.

The store? the Listening Post.

Pioneer PL-112D
& ADC 240XE Cart.
Orig. Price 139.00 NOW 85.00

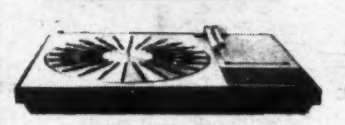
BIC-940
& Pickering XV15/400E
Orig. Price 191.00 NOW 125.00

Philips GA-212
& Stanton 681EEE
Orig. Price 251.00 NOW 169.00

Thorens 160c
& Stanton 681EEE
Orig. Price 331.00 NOW 249.00

Bang & Olufsen 3000
& B&O SP-12
Orig. Price 300.00 SAVE

Rabco ST-7
& B&O MMC-600
Orig. Price 525.00 NOW 449.00



Bang & Olufsen 4002
& B&O MMC-600
Orig. Price 690.00 SAVE

All turntables include Base & Dust Cover

the Listening Post
at ED'S TV & Appliance

1300 Park Ave. Woonsocket Right off of Rte. 146A
Open Daily 9 A.M.–8 P.M., Sat. 'Til 5. 769–5531 or 769–5550

NOTICE
BUYING

Tape Decks • Speakers
Dolby's • Receivers
Tuners • Amps
and Portable T.V.'s

We are the largest dealer in used equipment & spend the most bucks.

USED SOUND

8 Bow St.
Harvard Sq.
354-9734

249 Newbury St.
Boston
247-7707

We've never advertised to sell equipment.
Come in and see why.

Listening to your favorite records and tapes through the dbx 117 dynamic range enhancer is like having a new record collection. Now you can hear up to 20 dB of the missing dynamics the record or tape manufacturer sacrificed (for reasons we explain in our literature).

new record collection for $175

With the dbx 117 in your system you'll hear the higher harmonics of strings, the incisive bite of brasses, and the sharp attacks of cymbals and percussion as you've never heard them before except in live performance. As an added bonus, the dbx 117 substantially reduces record surface noise and tape hiss on playback, and adds dynamic range to records, tapes, and FM broadcasts.

To experience a totally new dimension in recorded music listening take your favorite record or tape to your high quality component dealer and ask him to play it through the dbx 117. For complete product information and list of demonstrating dealers in your area, contact:

dbx dbx, Incorporated
296 Newton Street
Waltham, Massachusetts 02154

Available at these fine dealers:

TECH HIFI
All Stores

K&L SOUND
Watertown

TWEETER ETC.
All Stores

MUSIC BOX
Wellesley

TERRY HANLEY AUDIO SYSTEMS
Cambridge

NATURAL SOUND
Framingham

SOUND-O-RAMA
Cranston, R.I.

ARMS

Continued from page 24

skating force varies with tracking force, distance of the stylus from the center of the disc, cartridge compliance, elasticity of the vinyl of which the record is made, etc. No currently available mechanism can provide correction perfectly, and most (magnetic devices excepted) contribute some friction to the system. Fortunately, these minor deficiencies have little audible consequence.

Still, some engineers quest for perfection; hence the development of the straight-line tracking arm, the other basic tonearm design. A straight-line arm has no horizontal pivot, moving instead along a track to one side of the platter. If the cartridge is properly installed, its stylus will always be perfectly tangent to the record groove. More importantly, there will be no skating force, as the direction of the force applied to the stylus by the moving record is always along the stylus-to-pivot axis.

Then why are so few arms straight-line devices? As is so frequently the case with best ways of doing things, it's not easy to make it work. The first commercially successful arm of this type was the Rabco SL-8E. It was a heavy, complicated, occasionally balky servo-controlled mechanism with a less than enviable reputation for reliability. Rabco also produced a turntable (the ST-4) with a similar but less-complicated arm. Both are out of production. A number of individuals and audio salons across the country make modifications to the SL-8E that substantially improve its performance and reliability. Meanwhile, Harman/Kardon has purchased Rabco and is marketing the ST-7 turntable, which features a better, much-simplified version of the original Rabco arm. B&O also makes a turntable with a straight-line arm, but it will accept only B&O cartridges.

One of the ways in which the new Rabco is said to be superior to the old derives from its "effective mass." Effective mass is one of the most important determinants of tonearm performance. It's not the actual mass of the arm — what you would feel if you picked the whole thing up — rather, it's the mass the stylus "sees." That sounds more mysterious than it really is. Just imagine yourself at a park with a child. The child sits on one end of a seesaw, while you stand at the other end and push down. The amount of force required to move the seesaw through a certain angle is proportional to the system's effective mass, which is obviously not the same as its actual mass.

Effective mass has some interesting characteristics. Obviously, increasing a system's actual mass tends to increase its effective mass: a particle's contribution to the effective mass of a system is directly proportional to its actual mass. But it's also proportional to the *square* of its distance from the pivot. In other words, moving the child in our example half way up the seesaw would have the same effect as replacing him with another child one quarter his weight at the end of the seesaw. To choose another example, a tonearm with a heavy counterweight near the pivot could have a lower effective mass than the same arm with a light weight farther away from the pivot.

The significance of effective mass is twofold. First, in an undamped arm it largely determines how close to the theoretically optimum tracking force — the force required for proper performance of a cartridge in a "perfect arm" — the nominal tracking force can be set. Nominal tracking force must always be somewhat higher than the optimum (which is a function of stylus-tip mass) to insure that while riding over warps the *actual* tracking force does not fall below the optimum, the result of which would be mistracking and attendant distortion.

The other important characteristic of effective mass is that it and the compliance of the cartridge determine the frequency of the low-frequency arm/cartridge resonance. Compliance is a measure of the springiness of the stylus suspension — the higher the compliance, the spongier the suspension. An arm's effective mass loads the stylus suspension in the same way that the weight at the end of a weighted spring loads the spring. All such systems have a natural resonance frequency at which they exhibit exaggerated response to perturbation. The frequency at which the resonance occurs is determined by the mass of the weight and the compliance of the spring. Consequently, all else remaining equal, the higher the arm's effective mass, the lower the resonance frequency. Likewise, the higher the compliance, the lower the frequency of the resonance. In arm/cartridge systems, the resonance manifests itself as a response peak, often as much as 10 dB in amplitude, at some very low frequency, almost always below audibility and sometimes as far down as four or five Hz.

Such resonance can cause a variety of problems. If it occurs at a frequency where the effect of warps is concentrated (typically in the two- to six-Hz range), the cartridge will track them poorly, perhaps even jumping out of the groove. Also, the warps (and all discs have warps, even if they're small) will cause disproportionately large outputs at these very low frequencies. This can cause preamp overload, power waste, higher speaker intermodulation distortion and acoustic feedback. (Acoustic feedback results when the tonearm vibrates in sympathy with the output of the speakers. It can make itself known in a number of ways. The most obvious is a howl from the speakers at high playback levels. Infrasonic feedback is more subtle, causing muddy bass and amplifier overheating.) Discs have a quiet region between eight and 15 Hz, which is the least-disturbing region in which to have a resonance. That being the case, and given that most modern, high-quality cartridges are highly compliant, low effective arm mass is highly desirable.

Effective mass is a less important variable in damped arms than in undamped arms. Speaking generally, a "damped" arm's pivot bearings are bathed in a viscous fluid (usually silicone) so as to squelch spurious oscillations. In a way, viscous damping is similar in effect to friction: both impede the motion of the arm. The very important difference is that friction tends to be highest at the onset of a movement and is otherwise nonselective, whereas viscous damping tends to ignore slow, small movements (such as those required for an arm to track discs) and to suppress sudden or large movements. That is, it behaves something like a car's shock absorbers. This is especially important with very low-friction arms, where an oscillation, once induced, can continue for a long time unless damped out.

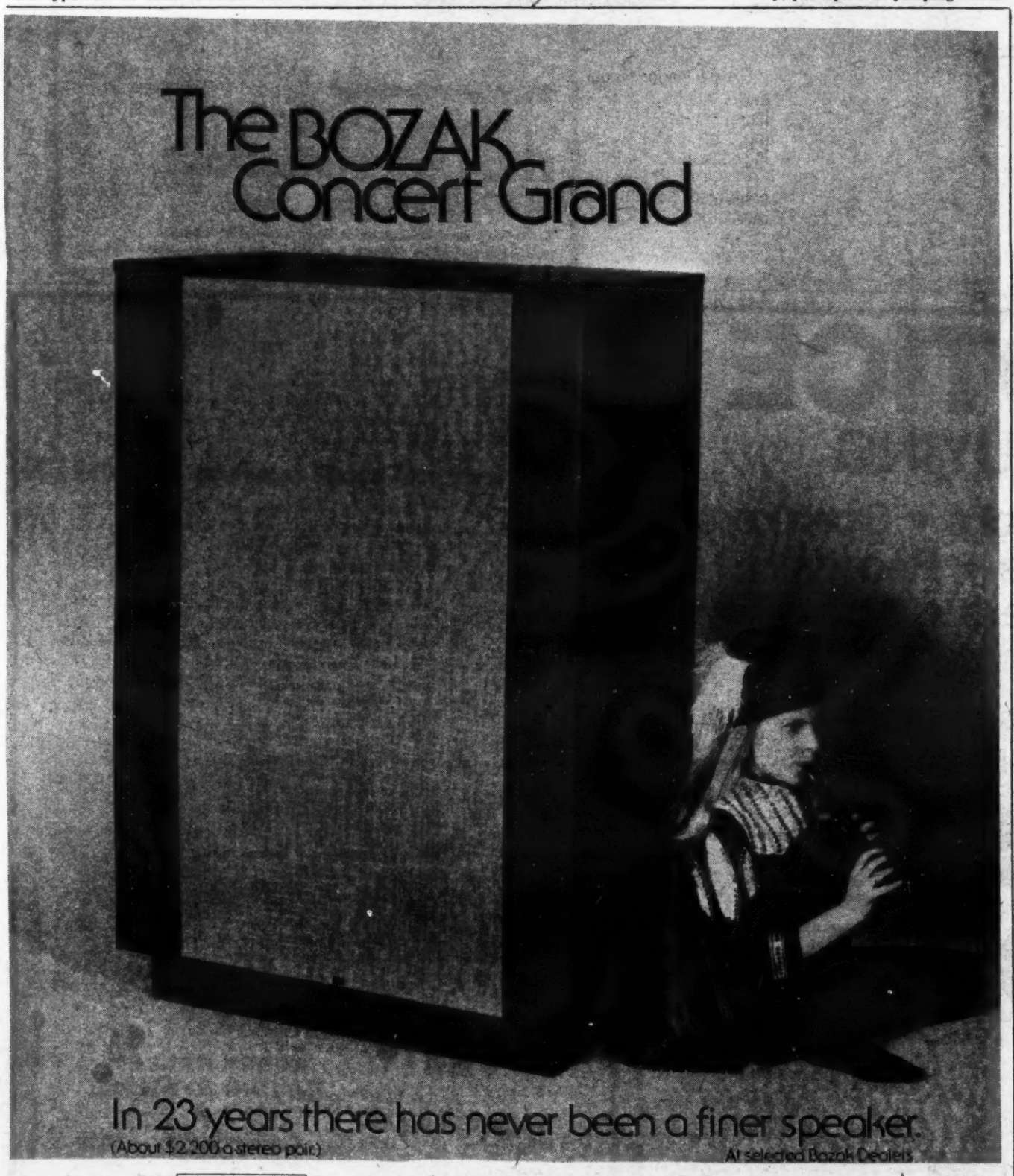
Damped arms characteristically produce better sound than undamped arms. In most cases, bass is firmer and better defined, treble is cleaner, and imaging is more precise and stable. Some, but not all, the reasons for this often dramatic improvement are known: the fluid lubricates the bearings, reducing friction; its damping action reduces the arm's susceptibility to external shock and acoustic feedback, and tracking-force variations are reduced and warp-tracking improved. Pivot-damping reduces also the amplitude of the low frequency resonant peak, thus making the placement of the resonance less critical, but this doesn't make arm mass a matter of no concern. An arm/cartridge system with a five- or six-Hz resonance, no matter how well-damped, will still pass to the preamp a lot of unattenuated infrasonic garbage, because the low frequency roll-off, which begins below resonance, starts at too low a frequency. A properly damped arm with a higher resonance frequency, say 12 Hz, will filter out most of the noise below that frequency.

Sadly, few arms are viscous-damped. Most, however (damped arms included), have elastically decoupled counterweights, which spread out the low-frequency resonance and reduce its amplitude somewhat. Often the decoupler is simply a rubber pad between the arm shaft and the counterweight. Another approach is that embodied in the Dual 701's resonance filters. They can be quite effective in reducing the amplitude of the resonance. Unfortunately, the filter is tuned to a specific frequency. If the resonance with a particular cartridge is not centered on that frequency, the filter will be less beneficial than it might. Viscous damping remains the best way to go.

Choosing an Arm

Now that you're ready to head down to your local audio empor-

Continued on page 28


The BOZAK Concert Grand
In 23 years there has never been a finer speaker.
(About $2,200 a stereo pair.)
At selected Bozak Dealers

Bozak
Darien, Connecticut

APT HI-FI
248 Worcester Rd.
Framingham
879-6550

MUSIC CENTER OF BOSTON
372 Boylston St.
Boston
267-3708

THE MISSING LINK

The first five seconds of every
Maxell UD cassette cleans your recorder heads.
Another Maxell exclusive.

The leader in our UD cassettes sweeps dust and debris off your recorder heads before they can foul-up a recording. And it sweeps gently, with no damaging abrasives to ruin your equipment.

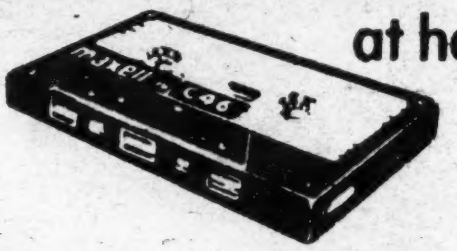
Our head-cleaning leader is also calibrated, so you can use it to cue your recordings.

It's on both ends of all Maxell Ultra Dymanic cassettes. It's another reason you can record the very best sounds (both high and low) your equipment produces, without tracking dust all over your music.

Maxell Corporation of America, Moonachie, New Jersey 07074. Also available in Canada.

maxell®

For professional recordings at home.



Available at any of these fine MAXELL gift centers

ARKAY ELECTRONICS
Watertown

ATLANTIS SOUND
261 Thayer St., Providence
38 Brattle St., Cambridge
1092 Commonwealth Ave., Boston
811 Boylston St., Boston
248 Worcester Rd., Framingham
10 Sylvan St., Peabody
So. Shore Plaza, Braintree
31 Broadway, New Haven, CT.
328 Main St., Worcester

COOP
M.I.T.
Harvard Square

COPLEY CAMERA
Boston

K&L SOUND
Watertown

MALCO
Lawrence

MANCHESTER MUSIC
Manchester, N.H.

MINUTE MAN
Cambridge

NANTUCKET SOUND
Hyannis
North Dartmouth

SOUNDSMITH
Portsmouth, N.H.

SOUNDTRACK
Woonsocket, R.I.

WALTHAM CAMERA
Waltham

TECH HI-FI
240A Newbury St., Boston
870 Commonwealth Ave., Boston
38 Boylston St., Cambridge
182 Massachusetts Ave., Cambridge
Route 9, Framingham
Route 1, Dedham
352 Main St., Stoneham
667 Main St., Waltham
279 Main St., Worcester
48 Teed Drive, Randolph
186 Main St., Northampton
259 Triangle St., Amherst
Hanover Plaza, Hanover
375 North Montello St., (Route 28), Brockton
Main St., Hanover N.H.
Nashua Mall Extension, Nashua , N.H.
150 Church St., Burlington, Vermont
21 Main St., North Bennington, Vermont
165 Angell St., Providence, Rhode Island
1989 Post Rd., Route 1, Warwick, Rhode Island

ARMS

Continued from page 26

ium, there are some specifics you should keep in mind. The arm you select should have an adjustable counterweight, which is used to balance the arm, and the weight should be decoupled. Tracking force usually is applied by a spring or by a weight moved forward on the arm. In other cases, the counterweight is moved forward, to unbalance the arm by an appropriate amount. This has the advantage of lowering the effective mass somewhat. (Moving a weight ahead of the pivot forward, i.e., away from the pivot, has the opposite effect.) It is best done with the aid of a good stylus force gauge. The Shure SFG-2, for about five dollars, is excellent. In fact, you may want one even if you use another method, as the adjustment scales on arms are sometimes inaccurate. You should also make sure that the arm can be balanced properly with a cartridge of the weight you intend to use and that it is designed for use at the tracking forces that cartridge requires.

If the arm is not of the straight-line tracking type, you should get an antiskating mechanism too, preferably an adjustable one. The force may be applied by a weight, by a spring or, perhaps ideally, by a magnet. Again, a scale is usually provided, though you may prefer to use a test record or make the adjustment by ear. It's usually not critical.

Check to be sure that some provision has been made for adjustment of stylus overhang. The manufacturer usually provides a gauge or an alignment protractor to facilitate this adjustment, which must be made precisely. Also, headshells on some arms can be twisted slightly to adjust the vertical stylus alignment. This is necessary because styli are frequently installed not quite perpendicular to the cartridge body. Unless corrected, such misalignment can cause loss of separation and accelerated record wear. If the arm you want doesn't provide for this adjustment, you may still be able to take care of it by using thin spacers between one of the cartridge mounting holes and the headshell. Just keep adding them till the stylus is perpendicular to the record surface.

Another thing to look for is a good cueing device, or "lift." The main requirement is that it be well-damped, with a very smooth descent. Many have a rough-textured surface on the support rod to hold the arm in place while it drops. This does insure minimum horizontal drift, but at the expense of stylus and record. For when the stylus first touches the groove, before the arm comes free of the lift, it begins to be pulled inward. Meanwhile, the lift is trying to hold it in place. The result is overflexion of the stylus assembly and momentarily high pressures on the outer groove wall. A smooth support rod minimizes these effects and therefore is superior.

As most cartridges with any pretensions of quality are highly compliant, it is advisable to select an arm of very low effective mass; more generally, the effective mass of the arm should be compatible with the compliance of the cartridge. The very best arms — e.g., the Formula 4, the KMAL, the SME, etc. — have effective masses between five and 10 grams. The arm that comes with the BIC changers has an effective mass of about 18 grams, which is probably a typical figure for high-quality changer arms, and is adequate for use with many cartridges.

You can and should employ a couple of simple tests for arm/cartridge compatibility. First, watch the woofer of a loudspeaker while playing a passage containing very little bass. If you can see the woofer bobbing around, the system is passing too much infrasonic noise. Then play a warped disc, preferably one with an edge ripple, and observe the stylus. If you see much motion between the stylus and the arm — if the stylus seems to jiggle — as they track the warp, the combination is probably not ideal. Failure of these tests is indicative of mass/compliance incompatibility, of inadequate damping or of both.

Finally, viscous damping is highly desirable, but few arms have it. Though there are some others, the ones that spring immediately to mind are the Formula 4 and the KMAL. If you really want the best, you should look into them.

What To Do About What You Have

By now, you may be sitting in front of one of your woofers, watching it do a belly dance. Despair not. There may be hope for that hunk of scrap iron perched on your turntable.

Perhaps the simplest modification that can be made is to drill and cut away the headshell till there's just enough of it left to provide firm support for the cartridge. This may also require that some of the counterweight be ground off, to make it possible properly to balance the arm. It's best not to do one unless you know you can do the other. After surgery, your arm's effective mass will be lower.

Adding damping is also fairly easy. You'll need a leakproof trough, a quantity of some viscous fluid (e.g., silicone, STP, etc.) and a couple of small paddles attached to a light, rigid support. The idea is to connect the paddle support to the arm near the pivot so that the paddles, one vertical and one horizontal, are in the fluid-filled trough. Experiment with different-sized paddles till you achieve the right amount of damping (squares about one-quarter inch on a side should be about right). Bear in mind that overdamping is worse than underdamping. It will, in addition to flattening the resonant peak, extend response well into the infrasonic region, interfering with the natural filtering action of the arm/cartridge system. In cases of gross overdamping, the natural movement of the arm may be impeded. Damp for minimum stylus and woofer bobbing, and expect the arm to feel a little stiffer than it did before. Take care not to spill any of the fluid. If it gets on belts or idler wheels, it will cause them to slip.

Another approach is to put a couple of drops of silicone on each pivot. This, of course, requires disassembly of the bearing housings — not a task to be taken lightly. You should know what you're doing before you try this. And you should recognize that none of this is likely to work well with automatics, as it would probably interfere with their automatic functions. The very ambitious may want to modify the pivots for lower friction. Some people have done wonderful things with AR arms this way. However, I recommend that you obtain a copy of the manufacturer's service manual, if possible. Finally, remember that modifying your arm will void the warranty.

Odds and Ends

Most turntables these days are quite decent. Only the least expensive produce audible rumble or wow. Still, very few have really good acoustic or mechanical isolation. It's not a matter of not knowing how. The AR turntable, which has been around for about 20 years, is arguably the best isolated turntable available. Manufacturers just don't bother. You should make a couple of tests. Tap lightly on the base of the turntable while a record is playing. There should be little or no disturbance of the arm. Then move the turntable in front of a speaker with healthy bass response and turn up the bass and volume. Listen for evidence of acoustic feedback. A good turntable should do well on both of these tests.

Remember that you pay a lot for that last iota of performance. Cartridge manufacturers often make a model very similar to their top-line unit that costs substantially less. Shure is especially notable in this regard. You may want to think about going for second best and putting the savings where they will do more good.

Finally, you should bear in mind that it's your record playing equipment that determines the life of your records. And no matter how good the rest of your system is, the best it can do is to reproduce what's fed into it. Don't skimp at the beginning of the chain. Lower-priced systems should have a larger proportion of their total cost in the turntable, arm and cartridge than higher-priced systems.

It's all here! The power, the precision, the purity. One look at that heat sink will convince you that no one puts your money where it counts, like Dynaco, into the guts of the Stereo 400. And what comes out is perfection.

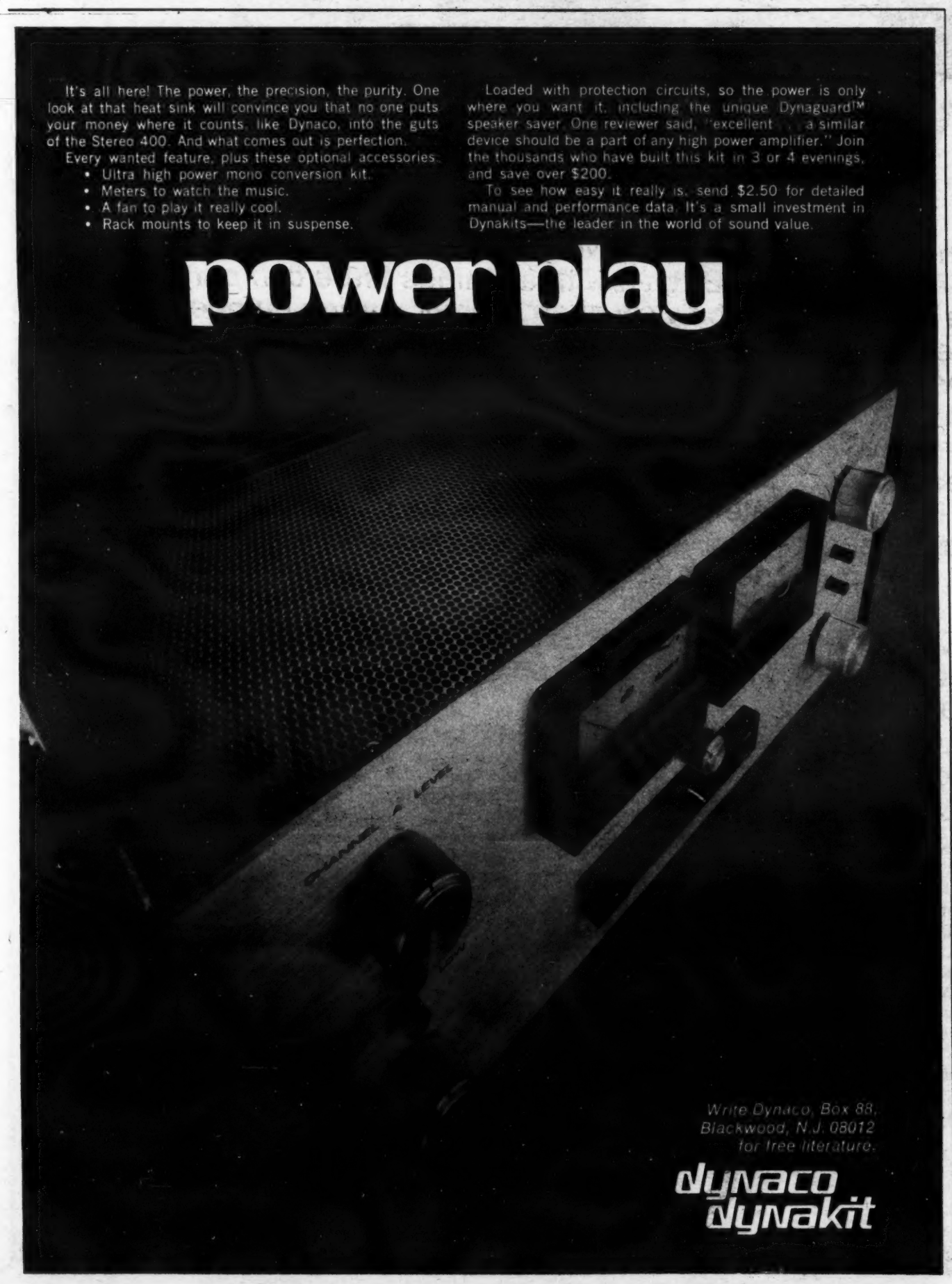
Every wanted feature, plus these optional accessories.

- Ultra high power mono conversion kit.
- Meters to watch the music.
- A fan to play it really cool.
- Rack mounts to keep it in suspense.

Loaded with protection circuits, so the power is only where you want it, including the unique Dynaguard™ speaker saver. One reviewer said, "excellent . . . a similar device should be a part of any high power amplifier." Join the thousands who have built this kit in 3 or 4 evenings, and save over $200.

To see how easy it really is, send $2.50 for detailed manual and performance data. It's a small investment in Dynakits—the leader in the world of sound value.

power play



Write Dynaco, Box 88, Blackwood, N.J. 08012 for free literature.

dynaco dynakit

Q. Why are the owners of Audio Research, Crown, Marantz, McIntosh, SAE, Yamaha and other fine tuners and amplifiers trading them in?

A. To buy Lux, the Ultimate High Fidelity components.

There are a number of very fine tuners and amplifiers available today. But, as with all things *there can only be one best.* And, in the view of an ever increasing number of discerning audiophiles (including those who already own very fine equipment) the best tuners and amplifiers are made by Lux.

And, we're happy to note, Lux need not be expensive. A full measure of Lux quality is available in the under $500 Model L-507 Integrated Amplifier. Rated by Lux at 50 watts RMS per channel at less than 0.05% THD or IMD 20Hz-20kHz. But typical performance exceeds even this stringent rating.

Avoid expensive trade-ins. Experience Lux — the Audible (and ultimate) difference *before* you buy your next tuner or amplifier.

Luxman — a complete line of tuners, amplifiers, preamplifiers and power amplifiers from $325 to $3000.

ULTIMATE HIGH FIDELITY STEREO COMPONENTS

LUXMAN

SUFFOLK AUDIO

1105 Mass Ave Cambridge, Mass. 617·868·1080

THE GROOVE LUBE

Waxing practical with Discwasher's Bruce Maier

by Peter W. Mitchell

Products which are claimed to clean records and render them static-free come and go like Presidential hopefuls. But for two decades the group of products designed by British engineer Cecil Watts (the Preener, Dust Bug and Parastat) have been widely regarded as the only effective, harmless, scientifically designed disc-cleaning tools.

During the past five years the pre-eminence of the Watts line has been challenged by several new product lines. The most successful of these is the Discwasher, an attractive soft-pile brush sold with a bottle of "D-II" fluid whose chemical formulation is said to be the key to the Discwasher's operation. The developer of the Discwasher, Dr. Bruce Maier, has published an inexpensive booklet entitled "Clean Records and Chemistry," describing the chemical and biological hazards in the record groove. So, rather than repeating that in the following interview, we asked Dr. Maier to discuss current developments in record care. He is 32 years old, articulate, passionately devoted to high-quality disc reproduction. Like many other successful innovators in the hi-fi industry, he is a hobbyist whose avocation blossomed into a business. We began by asking him what stimulated the initial development of the Discwasher.

Hizzoner the Maier

Bruce Maier: I studied in Missouri, Texas and Arkansas and ultimately got a Ph.D. in Infectious Diseases here in Columbia, Missouri. During that academic career, I was always an audiophile, and I was always discontented with existing record cleaners. I bought everything on the marketplace. While I was a graduate student, I found that my current record cleaner was growing a fungus in it. I was in microbiology at the time, and I knew that fungi could virtually eat and destroy anything. It turned out that records do occasionally support a fungus growth, and that this can be destructive.

So that was the starting point: I wanted a record cleaner that worked better, and also one that would antagonize a biological problem. I spent the better part of a year playing with fluid formulas, to find something that would actually deal with the problem of fingerprints and contamination better, and came out with a fluid that was pretty good. (In order to be a good biologist, occasionally you have to be a good chemist.) It looked like a marketable product, but at that time it was only a developed fluid for somebody else's handle system. So we worked at great lengths to come up with a better kind of delivery system.

Boston Phoenix: A better way of applying the fluid to the grooves?

BM: Right. And so finally we got this "directed-pile" fabric, which looked as if it had unique characteristics. Any other delivery system is what we call a pusher — all it does is line up the dust particles into an even line. The stylus tracks through that and sandwiches them back into the groove wall, which is just as bad as leaving them distributed over the record surface. We wanted something that would actually lift particles out of the grooves and onto a pad, to get them off the record. The directed pile did that.

There's been one update — a very significant chemical formulary update which resulted in the D-II fluid, and there was a significant update in the pad which incorporated a finer bristle and a higher absorbency level, all of which is important. If you have some fingerprints or some dust on the record surface, and you don't remove these, all you've done is distribute them in a nice even layer all over the thing again. So the idea is to have high absorbency.

BP: Is the fabric of the pad something that was actually designed for you, or is it something you discovered that was being made for something else?

BM: Initially, we took a preexisting prototype fabric. The fabric that we use right now is specially processed and done for us. And that is really a hassle. You really have to work very hard with fabric people to get something which is a workable specialty fabric, and I feel fortunate in that we have a really good company to work with.

BP: I was surprised a few min-

Continued on page 32

In the development of our $4000 state-of-the-art Servo Statik 1A we came across new principles which we determined to incorporate into less expensive speakers—principles concerning crossovers, and particularly the phase relationships of component drivers in a system. By properly balancing the phase leads and lags of each driver, and by scrupulous design of the drivers themselves, we are able to reproduce recorded temporal information absolutely accurately in a speaker of modest size and price.

Stated simply—there's a depth perception about the Monitor Jr. that is much like being in an acoustically perfect concert hall.

Listen to other speakers—even very expensive ones. In any one microsonic moment, generally the tweeter will speak first; then the midrange; then the woofer.

Listen to the Monitor Jr. It delivers the temporal information precisely *in* phase: first the transient attack, then the first echo, the second echo and the subsequent reverberation. You hear the natural, undistorted depth and ambience of the concert hall!

And note the spatial relationships of the instruments. If the tymps were on a riser to the left rear, they sound that way. If the clarinet soloist was in the second row just to the right of the podium, she sounds that way.

Our crossovers are greatly responsible for this dimensionality. Each of the six drivers of the Monitor Jr. system—our two sets of 12" transmission line woofers, our 1½" dome midranges and 1" dome tweeters—speaks with a temporal integrity and an individual accuracy of depth-information in a way that can only be called startling.

And note the optional $25 set of pedestals. They position the Monitor Jr. off of the floor for optimum reproduction; yet it functions beautifully on the bookshelf.

Our Monitor Jr. brings you the life-like warmth and accuracy of our Monitor II. And its price is roughly half—about $225.

Not a bad investment—to own your own concert hall.

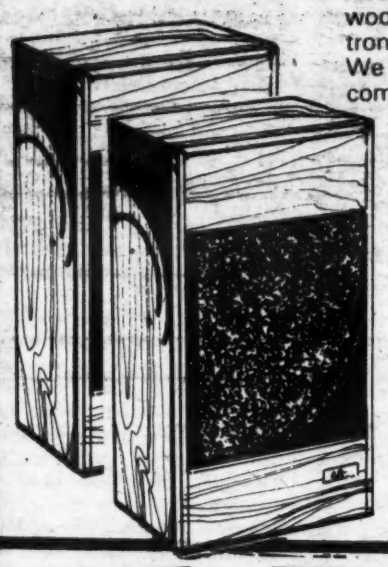
Step into Infinity's little concert hall: The Monitor Jr.

Infinity

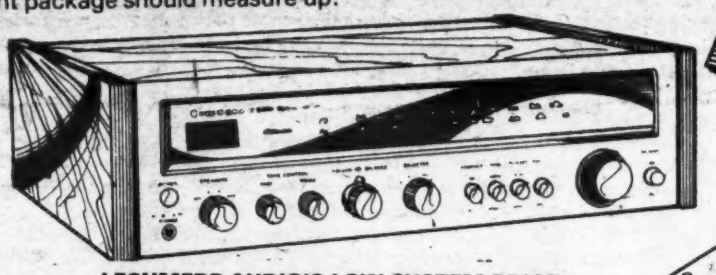
We get you back to what it's all about. Music.

©1975 by Infinity Systems, Inc., 7930 Deering, Canoga Park, Ca. 91304 • TWX 910-494-4913

DISCOVER YOUR WORLD OF SOUND WITH FAMOUS-BRAND HI-FIDELITY FROM LECHMERE AUDIO

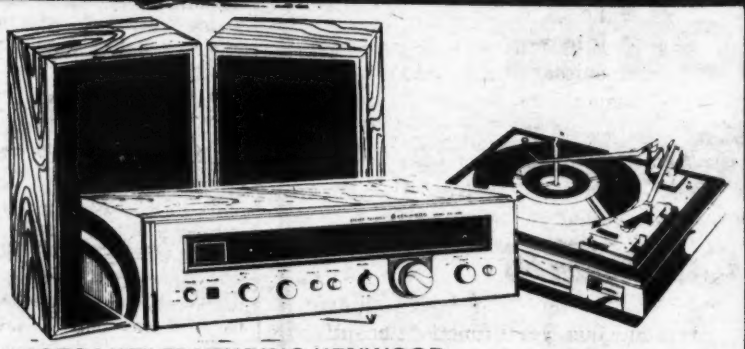


REFERENCE "1000" FEATURING KENWOOD KR-5400/AR-11/PHILLIPS GA-212/EMPIRE XL-31E - Truly, one of the finest component systems ever offered in this area. Each component is a masterpiece. The speakers are the AR-11 three-ways, the most accurate sound reproducers yet made by Acoustic Research. They are powered by the best-selling, full-featured Kenwood KR-5400 receiver. The turntable is the top-rated Phillips GA-212 electronic manual, complete with base, cover and Empire XL15/31E cartridge. We call this system "Reference" because it's the standard to which every component package should measure up.



LECHMERE AUDIO'S LOW SYSTEM PRICE

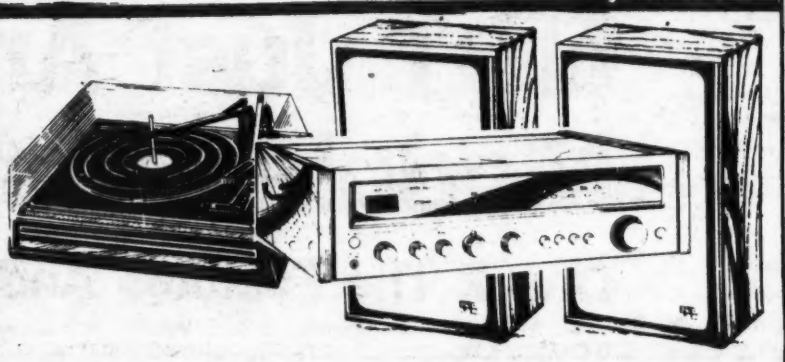
1,000.00



"HOTCAKE" FEATURING KENWOOD KR-1400/KLH 331/BSR-2260X - Our best-selling component package. It includes the feature-packed KR-1400 AM/FM stereo receiver with 10 watts RMS per channel, 40Hz to 20Khz, 0.8% Thd. Driving a pair of amazing KLH 331 two-way loudspeakers - updated versions of the popular 31's. For the record, the hardworking BSR-2260X with cueing, base, dust cover and Shure magnetic cartridge.

LECHMERE AUDIO'S LOW SYSTEM PRICE

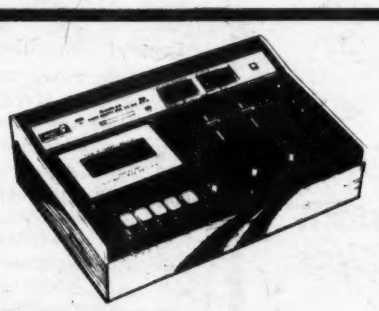
279.88



KENWOOD KR-2400/AVID 100/BSR-2310W MUSIC SYSTEM - Our mid-priced system, including the popular, feature-packed KR-2400 AM/FM stereo receiver, driving a pair of our best-selling, super-sounding Avid 100 two-way loudspeakers in handsome contemporary styling. Plus the BSR-2310W turntable complete with wooden base, dust cover and ADC elliptical cartridge that handles records with the most tender care.

LECHMERE AUDIO'S LOW SYSTEM PRICE

399.88



SANKYO STD-1410 DOLBY CASSETTE DECK - Our lowest priced Dolby cassette deck. It features more than just noise reduction. Other things like chrome tape switching, twin VU meters and total automatic shut-off. A great value!

SAVE 20.00

129.88

Lechmere Audio's Reg. Low Price 149.88

GARRARD 990B BELT-DRIVEN AUTOMATIC TURNTABLE - With the precision of a manual player and the convenience of a changer. Proven two-point record support, full-size platter, complete with walnut base, dust cover and feather light-tracking Empire XL15/31E cartridge.

SAVE 44.88

159.88

If turntable & cartridge purchased separately 204.76

AMPEX C-90 CASSETTE SPECIAL! 4 Ampex 20/20 plus studio quality C-90 cassettes and "Stackette" storage case for less than the price of two cassettes alone.

SAVE 11.03

7.88

If purchased separately 18.91

Use Your Lechmere Charge Card

LECHMERE the More store

WHERE YOU POCKET THE DIFFERENCE

Sale Prices in Effect Through March 6th

CAMBRIDGE, 88 First ST., 4961-2000, DANVERS, Liberty Tree Mall, Endicott St., off RT. 128, 777-1000, DEDHAM, 688 Providence Hgwy., RT. 1, 329-2200, SPRINGFIELD, Springdale Mall, 1550 Boston Rd., opposite Eastfield Mall, 543-5100. STORE HOURS: CAMBRIDGE, Mon. thru Fri., 10 A.M. to 10 P.M., Sat., 9 A.M. to 6 P.M., DANVERS, DEDHAM, SPRINGFIELD, Mon. thru Sat., 10 A.M. to 10 P.M.

MAIER

Continued from page 30

utes ago by your reference to the fingerprints on the grooves. One would get the impression that the grooves are sufficiently narrow so that if you handle the record carelessly, you would still only place fingerprints on the "land" areas between grooves, rather than actually getting down into the grooves.

BM: Sitting behind me there is an electron microscope, and I do a lot of microscopy. A lightly brushed fingerprint does not reach the grooves, but it has enough overhang that the stylus will pick it up and scrape it along from the top — that is, from the land — and smear it down into the groove.

Some people, especially people who have a tendency to perspire more than others and people who eat an awful lot of beef and pork tend to exude larger amounts of fatty deposits, and when these people handle records they tend to contaminate a record worse than, say, a fish-eater or a vegetarian. So there's a reasonable amount of biology involved in how we contaminate our records. As crazy as that might sound, it's also true.

BP: Which suggests that the Japanese are likely to have less difficulty with records than Americans.

BM: Or something like that, yes. Vegetarians will really like me.

Contrary to popular belief, the biggest single problem in record longevity is the dust which normally attracts to a record surface. Records all have a static charge built into them by the very act of the pressing. Microdust from the air will get onto the record, and even though a record looks clean, you can still have an even layer of microscopic dust; when the cartridge tracks, it will squeeze these particles into the vinyl. An electron micrograph will show that over a period of time, the groove contact area will become pebble-grained, and the signal-to-noise ratio is degraded, and the guy wonders why the hell his record's not sounding good.

Some people have recently claimed that it's because whenever you track a record, you shave the groove walls. I don't think anyone's done as much microscopy on tracking styli as I have, and a properly mounted cartridge system at reasonable pressure on a healthy record — that is, one which has its own lubricant system built in, which good vinyl does — does not "clip" or shave the groove.

Vinyl and Other Things

BP: The impression that styli tend to shave away material from the groove as they play the record might be due to the fact that even when you play a new record and then examine the stylus, you sometimes can see small amounts of black dust and goo on the stylus, which obviously must be vinyl because there's nothing else that's black.

BM: A lot of that is not vinyl per se. There's a multitude of compounds in a pressing operation, including stabilizers and lubricants. These can have carbon black in them. They tend to be waxy compounds — good, honestly legitimate, chemical lubricants. These lubricants, under conditions of shipping with temperature changes, can exude into the groove a little bit, and the first time you play a record, you can often pick some of those particles up on the stylus. These are not the vinyl, but additives.

BP: Are these additives responsible for the difference that many people find between American and European pressings?

BM: Actually, no. One difference is that some of the European people are very careful in the grading of their vinyl, and the other thing is that they simply press a record and then allow it to cool for a greater length of time. Once the waffle-iron has pressed itself onto the vinyl disc, the cooling cycle is very important, and the longer, more gradual the cooling cycle, the less deformation occurs on the disc itself. But in a setting where time is money, people tend to rush the cooling process and occasionally sacrifice record quality in the process.

BP: So there's nothing magical about European engineering being inherently better, it's just that they're not trying to economize quite so much in the pressing operation.

BM: That's true, although there are some highly revered European companies which have dropped to a sloppy third or fourth place in terms of record quality. We are geared to believe, for instance, that all DGG's [Deutsch Grammaphone's] are god-like in nature, and they are definitely not. In many instances they are inferior to American pressings. Vinyl is a petroleum product spin off, and if gasoline is selling for two dollars per gallon in Germany, I promise you DGG is going to try to economize as much as possible.

BP: What American companies do you find make disc pressings that are consistently as good as the European companies?

BM: Nothing is consistent. Any of the major record companies in America have produced outstandingly good quiet records. I wouldn't say that any one company is significantly ahead or behind. In the last calendar year the quality of American pressings has gone up significantly.

BP: Why?

BM: First of all, there was a time when vinyl was allocated like gasoline: nobody had enough and everybody was fighting for it. Vinyl is more available now, the general quality is better and it's easier to get and to test it. So now instead of buying blindly, people are making sure to get really good compound.

Another thing is that there has been an impression made by the people who want super records — that is, good records have sold more when all other things are equal. It's just good business to make a better record now.

The other good thing is that there are some performers who have gotten into audio. And when they go to their company and say, "Christ, I can't listen to my own records," they start to impress their quality-control desires at the bargaining table.

Watering the Grooves

BP: As many audiophiles discover that they've got more money invested in their records than in their equipment, record longevity becomes, forgive the pun, a more pressing problem. One technique that has been discussed lately is the idea of playing records with a film of liquid in the grooves. Claims have been made that this doubles the life of a record.

BM: Those studies were not done completely correctly. When you play a record, there's a tremendous amount of heat and molecular exchange going on.

BP: I've heard it claimed that actually there's enough friction at the point of contact between the stylus and the groove, that there is actually microscopic melting of the vinyl at that point.

BM: That's not true, that's a general conception, but probably the only thing that really does melt is the additive compounds. The real issue in those wet-play tests is that there is a recovery time of the groove's trauma. Those experiments were carried out by constant cycling, over and over and over — never giving the grooves time to recover. One of the things with the liquid was that it simply allowed the heat to dissipate easier and to lower the trauma.

Now let's look at what wet-playing does. Wet-playing, first of all, will extract some of these necessary stabilizer and lubricant compounds. Next, it is impossible to regularly wet-play and then clean the record so that you could ever listen to it dry again. You are forever locked into wet-play. The contaminants that remain on the surface are such that it's impossible to ever get away from it. Most disastrous, many cartridges — not all, depending on the type and the kind — are ruined because the liquid will wick up the stylus and short out the little generator assembly.

The Sound Guard

BP: The latest miracle in record preservation is American. Claimed to be a spinoff of the space program, a new product called Sound Guard from Ball Brothers has just gotten a rave review by Len Feldman in the March Issue of *Radio Electronics* magazine. He claims that by spraying this film on the record and then buffing it dry, leaving what is supposed to be a five-millionths of an inch dry film in the grooves, one can play records for a hundred times or more with no significant increase in noise or distortion, or loss of the ultrasonic subcarrier of a CD-4

Continued on page 34

NOT Just Another Modular System—

Check The Features And Compare!

SAVE $60.00

Magnavox Modular Music System with Cassette Stereo Tape Recorder/Player

NOW $189.95

Solid-State Stereo FM/AM Tuner/Amplifier — with FM/AFC, compensated loudness, continuously variable Bass and Treble controls, stereo balance control, stereo light, tuning meter and illuminated slide rule dial.

Full Size Automatic Record Changer — offers 331/3, 78, 45 speeds (adaptor included), automatic size select, diamond stylus, ceramic pickup, automatic anti-skate, manual cue control, lock-down slide latches, 4-pole motor, automatic shut-off, 10½" diameter turntable, manual tone arm lock and protective dust cover.

Built-in Cassette Tape Recorder/Player — has two rotary level controls, push-button function keys, automatic shutoff and eject, two record level meters, digital counter, direct internal recording from tuner, phono or auxilliary input jacks (such as 8 track player deck) and two inputs for microphones (not included).

Stereo Speaker System — has a High-Efficency 6½" and 2½" speaker in each cabinet.

Dimensions: Main unit — 22¼" L, 16½" D, 9¾" H. Speakers — 8¾" L, 6¾" D, 13" H. All units are constructed of sturdy wood products covered with durable vinyl for care-free good looks.

mastercharge

BANKAMERICARD

Magnavox

Home Entertainment Center

81 Arlington St., Boston • 426-1500

PAINE

minuteman—The Audiophile Store

Ambient, BGW, Celestion, Dahlquist, Denon,
Discwasher, Dunlap-Clarke, Fidelity Research,
Genesis, Grace, Harman/Kardon, IMF, Koss, Mark Levinson,
Nakamichi, Revox, SAE, Sonus, Supex, Stax, Yamaha. . .

If these names are unfamiliar to you, frankly you're not getting the best value for your audio dollar.

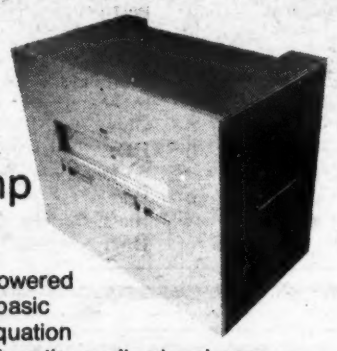
ONLY AT Minuteman NOW ON DISPLAY

A First in Greater Boston

STAX
We Love Our Products

DA-300

Class A Power Amp
150W+150W



DA-300 is the one and only high powered Class A amplifier in the world. Its basic design concept is to realize the equation "Input-Output" in sound quality when the audio signal passes through the equipment.
Advanced engineering and much effort in scrutinizing related parts succeeded in maintaining the total harmonic distortion less than 0.02% and in reproducing remarkably fidel and excellent sound.
With its proven static and dynamic characteristics, the DA-300 is superbly compatible with such world-renowned loudspeakers as JBL, ALTEC, AR, TANNOY, etc. as well as Stax electrostatic loudspeakers.
All protective circuits, such as protecting the amplifier from excess voltage input, abnormal DC flow, or overheating, and protecting loudspeakers in case of the amplifier failure, are cleverly engineered into the system.

$3600.00

STAX
We Love Our Products

SRA 12S
Dual Purpose
Preamp

The Stax SRA-12S is a high quality pre-amplifier as well as an integrated amplifier for Earspeakers.
It consists of the pre-amplifier section comprising an equalizer and an inter-stage amplifiers, and the main amplifier section for use with the Earspeakers. Employing more than 50 transistors, FET's or diodes, the SRA-12S is an ultra high fidelity amplifier, a crystal of advanced technologies.
The SRA-12S circuitry is completely devoid of elements deleterious to sound quality such as a filter, tone control, loudness control or chemical condensor. Its amplification between the MAG PU input and the preamp output is 60 dB, which means that a 1 V output can be obtained even when a cartridge of 1 mV class is in use.
As a pre-amplifier, the SRA-12S is a compact, light-weight and high quality component suitable for any stereo systems.
As a main amplifier for the Earspeakers, the SRA-12S with its 350 V high output can supply sufficient level of distortion free signals which will heighten the Earspeakers' superior features of clarity and presence.

$500.00

STRAIGHT LINE TRACKING SYSTEM

harman kardon **RABCO ST-7**

$400.00

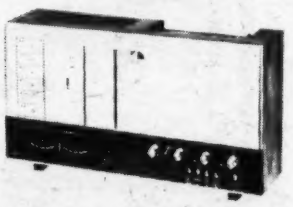
REVOX A700

The "big REVOX" closes the gap between top ranking amateur recorders and the full grown professional studio machines. Precision tape drive with three electronically regulated AC motors, three extremely stable tape speeds: 3¾, 7½ and 15 ips with the capstan motor speed phase locked to the crystal generators clock frequency of 1.6384 MHz. Synchronous speed indication by illumination of speed selector buttons. Possibility to vary the speed over plus/minus seven half tones with sync indication on the remote control device

$1800.00

NAKAMICHI

700
3 HEAD
CASSETTE
DECK



The most outstanding feature of this machine is its three-head configuration. Despite the minimal access to the traveling tape in a cassette, Nakamichi found a way to incorporate separate erase, record, and playback heads, thereby enabling the user to monitor a recording as it is being made, in the same way as when using a three-head open-reel deck.

$850.00

FIDELITY RESEARCH

FR-1
Mk 2

The FR-1/Mk2 moving coil phono cartridge is designed with the FR policy of keeping power generating systems free from ill effects of distortion created by magnetic materials. This is the highest class of moving coil cartridge available to the serious music lover and perfectionist audiophile.

$130.00

FRT-3

The FRT-3 is an ideal boosting transformer featuring a very unique structure. The FRT-3, however, employs special ring-shaped toroidal cores in place of the conventional set of cores to eliminate the detrimental distortion effect of magnetic material.

$150.00

minuteman

Cambridge at 30 Boylston St.
864-8727
Mon.-Fri. 10am-9pm
Sat. 9am-6pm

In Lawrence at 406 Essex St.
687-0777
Mon.-Fri., 11am-9pm
Sat., 10am-6pm

What's All the Static?

At this time every year, large numbers of audiophiles encounter the Rice-Krispies syndrome when playing records. Even well-cared-for discs exhibit frequent snaps, crackles and pops that intrude upon the music. It is especially frustrating to buy a high-priced European pressing, be annoyed by excessively frequent pops and crackles and return it to the store only to find that, when the salesclerk plays the offending disc, it sounds fine.

Static electricity causes this problem. Ordinary electricity consists of electrons flowing through a substance (such as metal) which offers little resistance to electron motion. "Static" electricity refers to the presence of quantities of electrons which are stuck where they are, unable to move to neutral ground because the medium they are in (or on) strongly resists electron flow. Vinyl plastic, the stuff records are made of, is such a medium. Electrons can't flow on vinyl unless they are helped by a dose of water vapor.

Water vapor is the key and is the reason static electricity causes seasonal annoyance on records. The air's ability to support water vapor is related to temperature — the higher the air's temperature, the more water vapor it can support. So during the three-fourths of the year when the temperature outdoors often stays 60°F. or higher, the air contains substantial quantities of water vapor. Even on an ostensibly "dry" summer day the amount of water vapor in the air is considerable (millions of molecules of H_2O per cubic inch). You can demonstrate this for yourself, as follows: chill a drinking glass in the freezer, take it out, quickly wipe it free of frost, then watch it. It will become rapidly coated with moisture. As warm air comes into contact with the cold glass it is cooled, losing its ability to support water vapor, so the cooled air literally "rains" its water vapor onto the surface of the glass. Repeating the same experiment on a cold winter day will yield relatively little condensation.

In wintertime, when the outdoor temperature is only 20 to 30 degrees Fahrenheit, the air contains little water vapor. The air in your cozy, 70 degrees-Fahrenheit living room is equally low in water vapor, since in most homes the inside air is just outside air that has been brought in and heated. So in winter, static electricity becomes a problem because there simply isn't enough water vapor in the air to help electrons flow on non-conductive surfaces. Low humidity can produce other difficulties as well, such as causing magnetic tape to become brittle and dropout-prone. It tends also to dry out and stiffen the elastomer stylus-suspension block which provides a phono pickup's compliance and resonance damping; the result is edgy, strident sound.

The most effective way to reduce record-playing static is to add water vapor to the air around the record player. If your turntable has a hinged dust cover large enough that it can be lowered in place while the record is being played, then an inexpensive approach can be effective. Glue a sponge to the inside of the dust cover (directly above the record), using water-insoluble glue. Then moisten the sponge and remember to keep the dust cover closed during play. Water will evaporate from the sponge and mix with the air in the enclosed record-player compartment, neutralizing static. One wetting of the sponge should be good for a full evening's listening. Don't get the sponge too wet, though, or it may drip onto your turntable.

Better yet, you can humidify the air in your listening room, with the aid of a vaporizer that costs from $5 to $100. This will provide a beneficial level of humidity not only for your records and tapes but also for you, for very low humidity levels are unhealthy. Increasing the relative humidity to at least 30 percent tends to make breathing more comfortable and reduces the incidence of nose and throat irritations.

Stores advertise dozens of fluids, sprays, cloths and gadgets to cure or prevent record-playing static. Even the best of these are less effective than simply humidifying the air, and the worst of them (the sprays and silicone-treated cloths) may be harmful to your records.

—P. M.

The Dual 1249

It will give you more reasons than ever to own a Dual

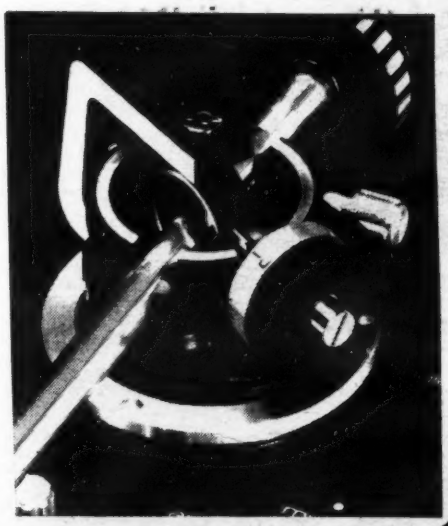
If you're really serious about your music — especially about your records — we believe you should consider the new Dual 1249 as your next turntable. Seriously.

It has every feature, innovation and refinement long associated with Dual turntables, plus some new ones.

The low-mass tubular tonearm pivots in a true four-point gyroscopic gimbal. Tracking is flawless at as low as a quarter of a gram. In single-play, the tonearm parallels the record to provide perfect vertical tracking. In multiplay, the Mode Selector lifts the entire tonearm to parallel the center of the stack.

The dynamically-balanced cast platter and flywheel are driven by an 8-pole synchronous motor via a precision-ground belt. Pitch is variable over a 6% range, and can be conveniently set to exact speed by an illuminated strobe.

Of course, if you already own a current Dual, you won't really need a new turntable for several years. But if you want the turntable that High Fidelity magazine describes as a "further step in the direction of automatics that cannot be distinguished from manuals in terms of performance measurements"... you should come in and let us demonstrate the new Dual 1249.



The 1249 tonearm pivots in this four-point gyroscopic gimbal. Each gimbal is hand-assembled, and special gauges assure that each will conform to Dual's tough specifications.

Dual

See the new Dual 1249 at

FACTORY SOUND

799 Boylston St.
Boston

291 Harvard St.
Brookline

MAIER

...ed from page 32

record. If his report is to be believed, the stuff is fantastic. But it's hard to believe that things are that simple.

BM: Things are not that simple, including his micrographs. You can make any cartridge "clip" a record, and you can show a lot of things. I stand by my original statement, and that is that properly-mounted cartridges in good equipment do not shave records. The Ball product is in some applications a valid product, and it's totally consistent with Discwasher's product. Because if you don't have a clean record, the Sound Guard will sandwich stuff into the grooves and that's worse yet. There is no substitute, in the final analysis, for a clean record.

BP: Given that one cleans the record before one sprays the Sound Guard film on, is it still reasonable to suppose that so thin a film will sufficiently harden the vinyl as to cut the wear?

BM: First of all, it does not harden the vinyl. All it does is act as a lubricant. And I promise you that improperly mounted cartridges will still shave those grooves.

In order to perform those wear tests, you subject a record to undue stresses by playing it over and over again. You need a minimum of 30 minutes (and as much optimally as four hours) between playings for a complete molecular recovery to occur.

BP: I've even heard claims that you ought to let a record rest as much as 24 hours between playings.

BM: That might be a long-term ideal, but the real world says four hours does it. And you can get by, with really good equipment, with about 30 minutes. So what we're saying is, there is no compound that is going to make up for lousy equipment, and good equipment will generally let you get by anyhow. And anytime you have anything that adheres to a record surface, you must be cautious. That's why we have a system, the Discwasher, which is designed to deal with problems on record surfaces and then get them off. We have a directed pile and a chemically balanced fluid. You've got to get things off the record.

BP: Does the Discwasher make any attempt to deal with the problem of static in records?

BM: No, at no time does the Discwasher claim to be anti-static. . . . You don't get an anti-static product without coating the record surface. In the case of the Ball product, we have not been able to demonstrate scientifically that there is actually an electrostatic diminishment. When you clean with the Discwasher you will temporarily relax the static charge. But records themselves have a charge, and they will re-charge. Static is best handled by a true static-equalizing device.

BP: When playing records, inevitably you get a build-up of material on the stylus tip, which itself reduces the tracking properties of the stylus. Might it also eventually become a grinding agent as you play the records?

BM: Let's presume that someone has a good cartridge, and that it's mounted correctly so that it will not shave the vinyl, but it will, occasionally, pick up additive compounds which have been secreted into the groove areas. These compounds do pick up on the stylus, and they do act as an abrasive, and that's the other major point of record destruction. That's why we have a stylus cleaner. We spent a year testing brushes to find one that would clean the stylus safely. Especially when used with a small amount of D-II fluid, it does an excellent job.

AUDIO STUDIO MARCH SALE

marantz

1060 Amp	169.00
2245 Receiver	329.00
1030 Amp	109.00
115B tuner	199.00
3200 Pre-Amp	179.00
140 Power Amp	235.00
2325 With built-in Dolby FM Receiver	639.00
4G speakers (by pair)	94.00
150 tuner with 4 channel scope	489.00

PE

3048 Complete turntable with Shure M91ED cartridge	134.00
3060 Complete turntable with Shure M91ED cartridge	169.00

AR

2AX speakers (by pair)	249.00
XB complete turntable with Shure M91ED cartridge	119.00

ADVENT

Lg. Advent utility speakers (by pair)	199.00
Lg. Advent walnut speakers (by pair)	119.00
Small Advent speakers (by pair)	149.00

SONY

TC153SD Dolby portable cassette deck	309.00
TC377 reel to reel tape deck	325.00
TC280 reel to reel tape deck	249.00
TC10 car stereo cassette player	109.00
ECM 220 condenser microphone	39.00
TC135SD Dolby cassette deck	199.00

March to Audio Studio for big savings on all lines of stereo hi-fi equipment
EXPERT REPAIRS ON:
Ampex, AR, Crown, Garrard, P.E., AKAI, Kenwood, Scott, Dual, KLH, Sherwood, Dynaco, Marantz, Sony, Fisher, Revox, Thorens, Miracord, Wollensak, Craig, BSR, and many more.
We give a 100% guarantee on all the work we do. Problems with your present components? Call us and it will be our pleasure to help you.

AUDIO STUDIO
414 Harvard St.
(Across from King Bagel)
Brookline Tel: 277-0111

Dual

1226 complete turntable with Shure M91ED cartridge	139.00
1228 complete turntable with Shure M95ED	163.00

JENSEN

6x9 20 oz. coaxial car speakers (by pair)	43.00
4in. 10 oz. coaxial car speakers (by pair)	37.00
Unimount surface or recess car speakers (by pair)	27.00

dynaco inc.

A25XL speakers (by pair)	147.00
Dyna FM 5 tuner (demo)	139.00
PAT4 Pre-amplifier (used)	89.00
Stereo 70 power amp (used)	89.00
SCA 35 amp (used)	69.00

HARTLEY

Zodiac 1 speakers (by pair)	159.00
Zodiac 75 speakers (by pair)	229.00
Zodiac 300 speakers (by pair)	350.00

THORENS

TD165 complete turntable with Shure M91ED cartridge	143.00
TD125AB MkII complete turntable with Shure V15III cartridge	369.00

SUPERSCOPE

C105 portable cassette	119.00
C104 portable cassette	79.00
C102 portable cassette	59.00
C106 mini portable cassette	79.00
C108 mini portable cassette	119.00
T220 AM/FM tuner	109.00
S16A Speakers (by pair)	43.00
A245 amplifier	75.00

KOSS

HV1LC high velocity headphones	34.00
HV1A high velocity headphones	31.00
PRO 4AA dynamic headphones	32.00
K6 dynamic headphones	17.00

SHURE

M91ED cartridge	21.00
M95ED cartridge	27.00
V15III cartridge	57.00
VN35E elliptical stylus	31.00

PIONEER

SX636 receiver	259.00
KP4000 in-dash cassette with AM/FM	137.00

NORDMENDE

Type 804 speakers (by pair)	239.00
Type 802 speakers (by pair)	129.00
CR 410 portable cassette recorder with AM/FM Short wave (switchable voltage)	89.00

NEW EQUIPMENT

Receivers Amps, & Tuners	
Fisher 4025	200
Marantz 150	489
Superscope A245	75
Marantz 115B	199
Pioneer Sx636	259
Speakers — by pairs	
Advent Large Utility	189
Hartley Zodiac 75	229
Hartley Zodiac 1	159
Marantz 4G	94
Dyna A25XL	147
AR-2AX	249
Cartridges	
Audio Technica AT125	39
Pickering PATE	16
Shure V15111	57
Shure M95ED	27
Shure M91ED	21
Stanton 681EEE	43
Stanton 600EE	29
Stanton 500EE	22
Pickering XV15200E	24
Cassette Decks	
Superscope C104	79
Superscope 105	119
Superscope CRS152	159
Teac A360S	299

NEW EQUIPMENT

Cassette Decks	
Superscope C106	79
Superscope C108	119
Sony 121A	99
Sony TC-110B	119
Cassette Tapes	
BASF C90 SKLH	1.89
BASF C120 SKLH	1.99
BASF C90 CR02	2.99
BASF C90 LH Super	2.89
Columbia C60	1.30
Columbia C90	1.89
Scotch C451	1.19
Scotch C60	1.35
Scotch C90 CR02	2.89
Sony FECR60	2.99
Sony CR02 C90+2	3.19
Superscope HF92	1.99
Maxell UDC-90	3.39
Turntables	
Bic 960	129
BSR 2510X	74
BSR 2310X	68
BSR4800 BX	39
Dual 1226Complete	139
Dual 1228 Complete	168
PE 3060 Complete	169
Thorens TD165Ccomplete	143

USED-U DEMO-D

Speakers—by pair	
Advent Large Utility (d)	175
JBL C56 (u)	419
Receivers, Amps & Tuners	
Dina SCA-35 (u)	69
KLH 55A (d)	179
McIntosh MX12 (d)	429
Dyna PAT4A (u)	89
H. K Citation IIIX	129
Dyna FM5 (d)	139
Marantz 1070 (d)	209
McIntosh MA230 (u)	299
Dynaco Stereo 70 (u)	89
Sony STR 6046 A (d)	199
Yamaha MC600 (u)	249
Turntables (complete)	
Garrard LAB65B (u)	59
Dual 1226 (d)	99
Benjamin Miracord 50HII (d)	139
Sony 1800A	129
Cassette Decks & Reels	
Sony TC 165 (reversed) (U)	139
Revox A77	595
Tandberg 9200SD (u)	699
Braun TG100014 (u)	500
Sony TC20 (u)	59

All Used & Demo Equipment FUlly Guaranteed

---

hy-gain CITIZENS BAND TWO-WAY RADIOS

hy-gain has a "CB" radio to fit every pocketbook. . . units start at

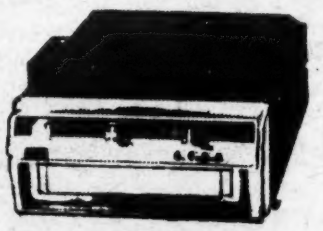
$139.95

Unit Pictured — HyRange III $239.95

Complete Line of CB Antennas Also In Stock At Prices Well Below Car Factory.

10% Less Than Our Regular Low Prices With This Ad Through April 1, 1976

OTHER SOUND SPECIALS



JIL 8 TRACK SPECIAL!
29.95 with this ad

AUDIOVOX FMC-1C FM CONVERTER
27.95 with this ad

Regency
$169.00
3 Band
10 Channel
Scan Action

1,001 ITEMS FOR YOUR CAR
ELLIS INC
"ELLIS THE RIM MAN"

782-4777
1001 COMMONWEALTH AVE.
BOSTON, MASS. 02215
1 BLOCK FROM THE ARMORY
master charge bankamericard american express

SAMETRON SAMETRON SAMETRON SAMETRON SAMETRON

SAMETRON

CAN MAKE YOUR
OLD STUFF SOUND
LIKE NEW. . . AND YOUR NEW
BETTER THAN NEW. . .

BLAUPUNKT · GRUNDIG · NORDMENDE · SUPERSCOPE. · becker · Panasonic · TELEFUNKEN · SONY · Garrard · UHER · Dual · PIONEER · Akai · Sansui · TANDBERG · UHER · PHILIPS · ZENITH

THAT'S BECAUSE OUR PROFESSIONAL TECHNICIANS USE ONLY *GENUINE REPLACEMENT PARTS.* SO THE NEXT TIME YOU WANT TO HEAR SOMETHING NEW FROM SOMETHING OLD GIVE US A CALL. . .

SAMETRON

401 HIGHLAND AVENUE SOMERVILLE, MA
625-8777 **AT DAVIS SQUARE** **623-9150**

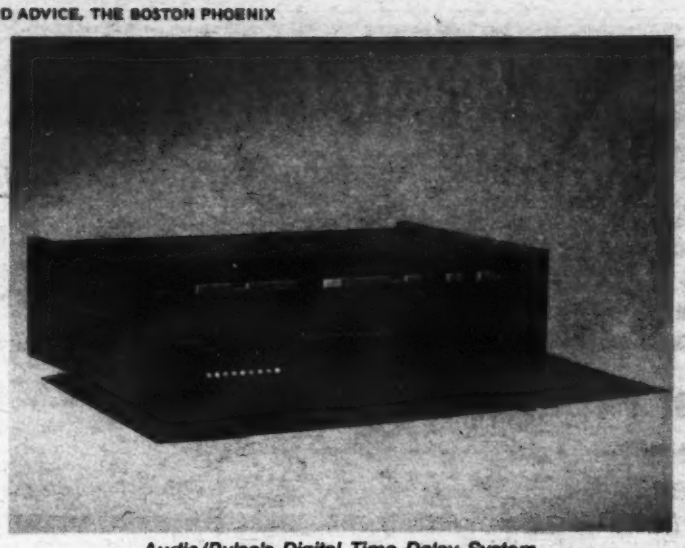
THE **ONLY** *CENTRE PROPERLY EQUIPPED TO SERVICE THE* **FOREIGN AUDIO PRODUCTS**
RADIOS•TAPE RECORDERS•STEREOPHONIC•TV
HIGH QUALITY SERVICE — LOW PRICES

SAMETRON SAMETRON SAMETRON SAMETRON SAMETRON

DELAY

Continued from page 3

the clock, a voltage equal to the signal voltage at that instant is stored in one stage of the IC. At the next tick, that charge moves on to the next stage in the IC, and its place is taken by a new sample of the input. (The sampling takes place at such short intervals that the ear cannot detect the discontinuity it introduces.) This process continues until the original sample charge passes out of the IC, up to 50 milliseconds later, and on to an expander-deemphasis circuit complementary to the compressor-preemphasis circuit at the beginning. From there it passes through a six-dB-per-octave high-frequency rolloff network, with a switch-selectable knee frequency, then on to the output and to the reverberation circuit.



Audio/Pulse's Digital Time Delay System

The reverb circuit picks off a signal from the output (the level of which is determined by the front panel reverb control), which passes through another high-frequency rolloff and into the input of the opposite channel. The rolloffs are provided to simulate the progressive absorption of highs as they bounce around a hall. The recirculation process keeps the coherency of the sound from the rear speakers low, as it would be in the reverberant field of a hall.

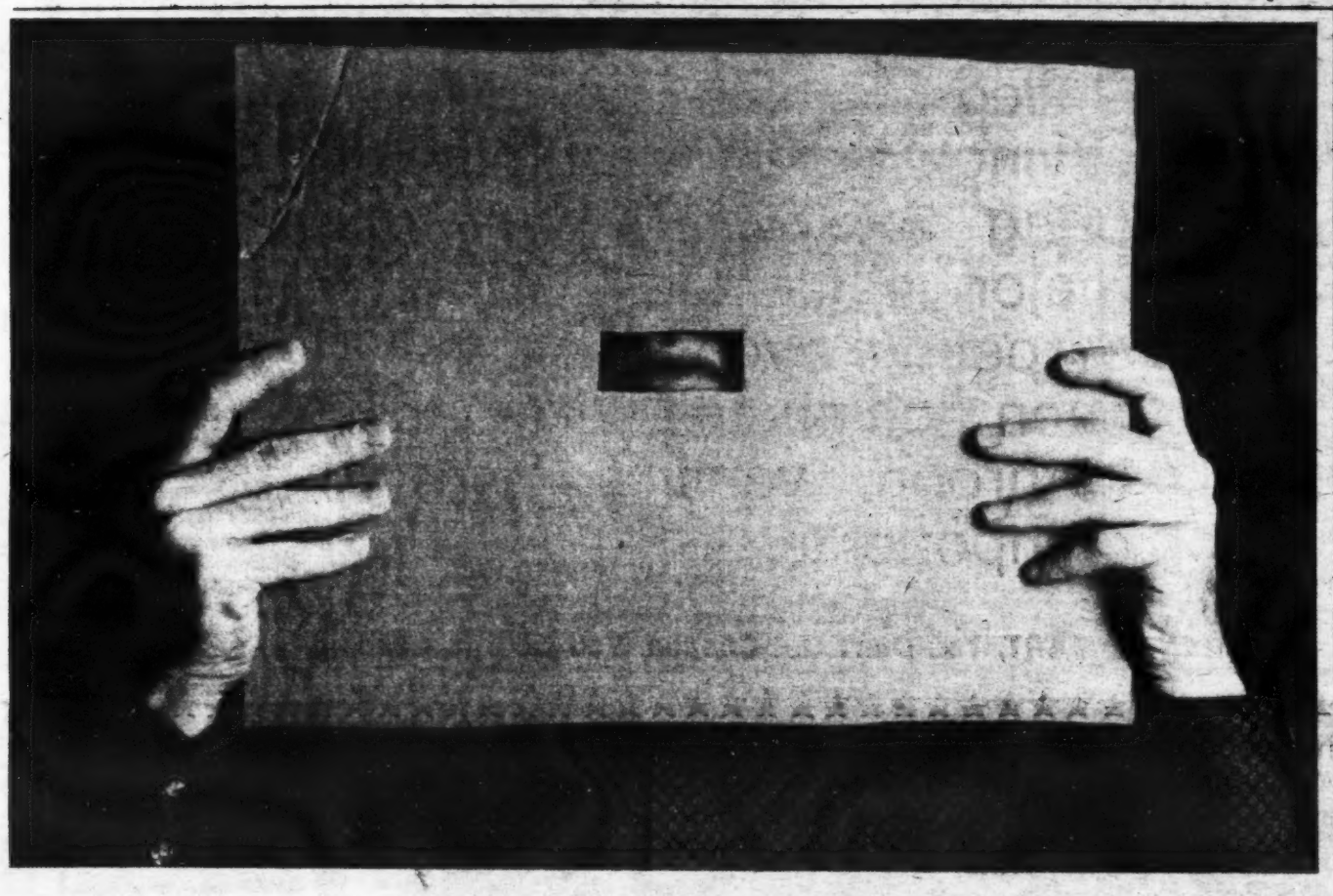
The Audio/Pulse unit is in some respects similar to the Sound Concepts SD-50. The input passes through an eight-kHz low-pass filter and a compressor-preemphasis network. But from there it goes to an analog-to-digital encoder. This is a sophisticated device that tracks the direction of voltage changes in the input, registering 1 for up and 0 for down. Again, there's a clock that determines the sampling rate. At every cycle, the output, 1 or 0, from the encoder passes into a shift register memory. At each tick of the clock, the digit is shifted down one register in the memory. Unlike the SD-50, which uses only one delay, the Audio/Pulse uses two, one shorter than the other. Hence, each digit is picked off twice. For each delay circuit, it is passed through a separate digital-to-analog decoder, which reconstructs a delayed analog signal from the output of the shift registers. The outputs from the two decoders are mixed and sent through an expander-deemphasis segment. The signal is then smoothed and passed on to a mixing and phase-shifting network between the two channels and to a reverberation circuit, which sends an attenuated signal to the input of the opposite channel. Great care is taken that the final output signal be thoroughly scrambled, as it would be in a concert hall.

The two units offer some different options to the user. The SD-50 provides great flexibility within its design limits. The amounts of delay and reverberation are continuously variable, giving the user maximum discretion to "fine tune" his listening room. It has also four different rolloff settings at three dB intervals, flat to -9 dB at seven kHz, each signifying a slightly lower frequency for the onset of the rolloff. This allows the listener to compensate for the relative liveness or dullness of his room. The Audio/Pulse, on the other hand, provides 22 switched delays, which are determined by the relative mix of short and long delays for the two available clock rates. (The SD-50 uses a variable clock.) Because it uses digital encoding, the Model One can produce delays twice as long as the longest available from the SD-50. Also, it has a bass boost circuit, which is turned on or off by a switch on the back panel.

Unless you already have a four-channel set-up, it will be necessary for you to buy another power amplifier and another pair of speakers to make use of either of these boxes. Fortunately, the rear speakers need not be anything fancy, as there's nothing coming out above 10 kHz. What's mainly required is a smooth midrange and, if possible, a respectable bass range. The costs do mount up, and there's not much likelihood that the prices of delay lines will come down in the immediate future.

Take solace though that your source material will not be obsolete. In fact, these things do even more for mono than they do for stereo. It's simply amazing how good an old mono disc can sound when one of these units goes to work on it. The sound of any disc takes on a warmth, body and dimensionality that just aren't there without delay, and without sounding synthetic. In fact, delay lines seem to bring out the ambience already on records, to the extent that one learns quite a bit about the space in which the recording was actually made. (Increasing the delay time increases the subjective size of the room. Usually for each recording there's a size that sounds right, as though that were the actual size of the room in which the music was played.) On concert recordings, it sounds as though one is actually sitting in the audience, surrounded by people. But, at the same time, the effect is subtle. One isn't (or shouldn't be) aware of the sound from the rear speakers, but the effect of switching them out is dramatic. The sound becomes flat and lifeless as it suddenly collapses into the front of the room.

The two units do sound different; the Audio/Pulse is somewhat more dramatic. By all means go and listen, and let your own taste guide you. A word of warning, though: if you're not ready to buy, be prepared to be frustrated. Once you've heard audio delay, you won't want to live without it.



Turn yourself into a remarkable speaker demonstration.

To begin, just find a piece of heavy cardboard or corrugated carton about 14" x 20" and cut an opening in the center like the one above. Now you're ready! Grab a friend, your wife, your mother-in-law—anyone who can bear to hear you ramble on for the next 30 seconds. Hold the contraption you just made to your face so that your lips are against the opening and start talking. Now, take it away quickly as you continue to talk. Then hand it over and let the other person talk, with and without the cardboard.

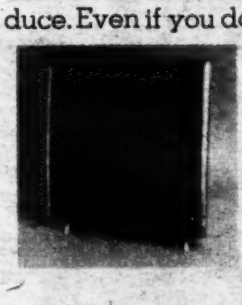
If all went well, you probably noticed a coloration in voice quality whenever the cardboard was held up.

In essence, what you just did was to simulate the way every enclosure type of system is affected by the baffle board its speakers are mounted on. You became the speaker and the cardboard became the baffle.

As you spoke without the cardboard, the sound waves reached the listener normally. But when you spoke holding up the cardboard, some of the sound waves from your voice traveled along the surface of the cardboard until they reached the edges, the way they do on a conventional speaker. The sharp discontinuity caused an effect called "diffraction," which allows these waves to be heard too, but later than the original sound. This is what produces the unnatural coloration you heard.

But the Dahlquist DQ-10 overcomes this problem through an ingenious free-air mounting configuration which has no large baffle surfaces to color the sound. At the same time we are able to reduce time-delay distortion, since all drivers are mounted in the correct acoustical plane.

The end result is sound that is so natural and open in quality that you will realize just how much coloration enclosure type speakers produce. Even if you don't want to go to the trouble of doing our little home demonstration, any Dahlquist Dealer will be happy to do it for you, using a DQ-10 instead.



DAHLQUIST
The boxless speaker
27 Hanse Ave., Freeport, N.Y. 11520

See The Dahlquist Line At:

MASSACHUSETTS
Minuteman Radio
30 Boylston Street
Cambridge • 864-8727

406 Essex St.
Lawrence • 687-0777

Hi-Fidelity House
261 Park Avenue
Worcester • 799-9737

Tripod Audio
219 Main Street
Northampton • 413-584-6498

RHODE ISLAND
Delta Hi-Fi
420 Hope Street
Bristol • 401-253-2333

NEW HAMPSHIRE
Manchester Music
968 Elm Street
Manchester • 603-623-3536

MAINE
New England Music
713 Congress Street
Portland • 207-772-2869
Also in Bangor,
Lewiston and Waterville

BRANDS MART

DISTRIBUTION CENTER

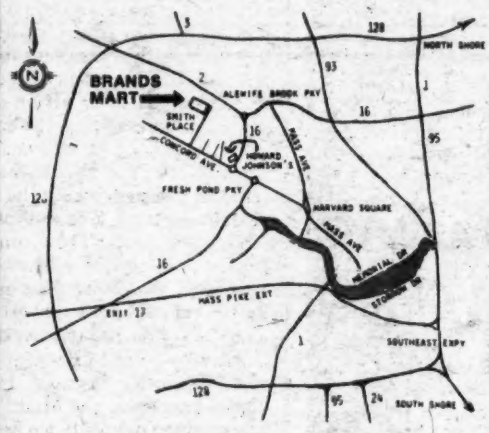
127 Smith Place (near Fresh Pond) Cambridge • 547-6900

HOURS: Mon. & WED. 9-9 • TUES., THURS., AND FRI., 9-6 SAT. 9-4

We're off Concord Ave., between Fresh Pond Shopping Center and Sancta Maria Hospital, easily accessible by the Concord Avenue Bus out of Harvard Square

1) Not open to dealers. 2) One coupon ner customer. 3) One coupon per item. 4) Expiration dates strictly adhered to. 5) Not responsible for typographical errors.

Other Brands Mart Locations: 41-50 22nd St., Long Island City, N.Y. 915 Grand Ave. New Haven, Ct. 120 E. Industrial Court, Deer Park, N.Y.



If you have a **BRANDS MART Card** or College I.D. take advantage of the extra savings being offered right here. Just bring your CARD and you'll save on major appliances, bedding, furniture, carpeting, eyeglasses, jewelry, TV's, kitchen cabinets, air-conditioning, and bathroom vanities, as well as audio components.

At BRANDS MART, You Don't Get Clipped; You Do The Clipping

THORENS **TD-145C AUTOMATIC TURNTABLE**
with tonearm, dust cover, base
and ADC **QLN Cartridge**

BOSE **2 BOSE 301 LOUDSPEAKER SYSTEMS**

marantz
2220B AM/FM STEREO RECEIVER
20 watts per channel RMS at 8 ohms, 20-20,000 Hz .05% THD (shown with optional walnut case)

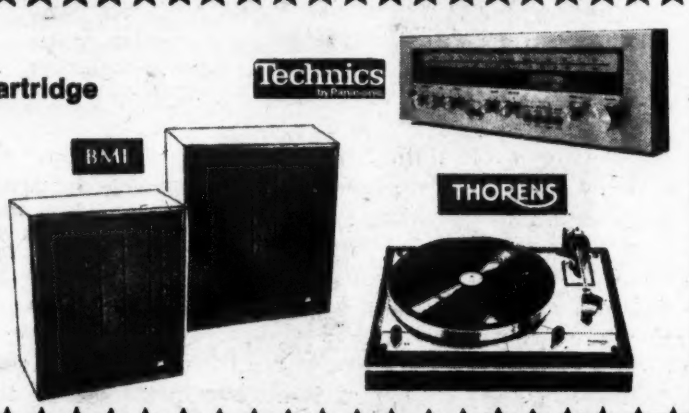
UNBELIEVABLE LOW PRICE
$529

THORENS **TD-165C 2 SPEED INTEGRATED TRANSCRIPTION TURNTABLE**
With tonearm, dust cover, base and STANTON **600EE Cartridge**

BMI **2 BMI MARK 99 LOUDSPEAKER SYSTEMS**

Technics by Panasonic
SA5350 AM/FM STEREO RECEIVER
28 Watts per channel RMS at 8 ohms, 20-20,000 Hz. 0.5% THD

UNBELIEVABLE LOW PRICE
$859

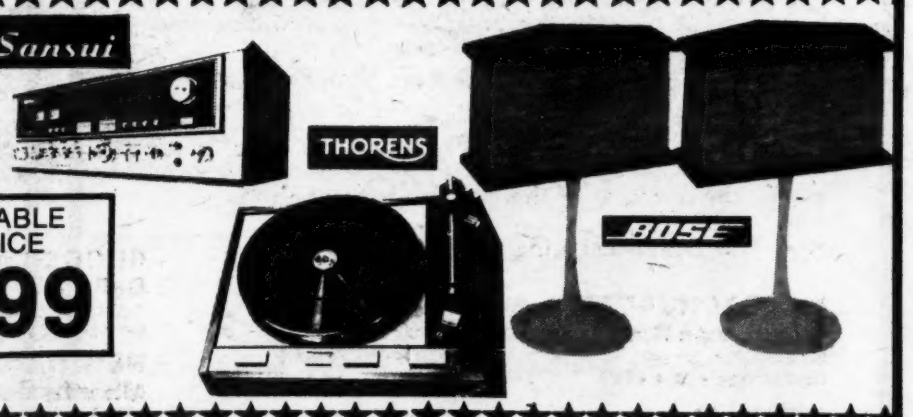


THORENS **TD-125 AB Mark II 3 Speed Electronic Transcription Turntable**
With tonearm, walnut base and
SHURE **V15 Type III Cartridge**

BOSE **2 BOSE 901 Direct-Reflecting Loudspeaker Systems**
(shown with optional stands)

Sansui
9090 AM/FM STEREO RECEIVER
110 Watts per channel RMS at 8 ohms, 20-20,000 Hz. 0.1% THD

UNBELIEVABLE LOW PRICE
$1299



If you do not presently have a college I.D. or a Brands Mart courtesy card, and you are interested in obtaining a Brands Mart courtesy card, have the head of your organization, union or personnel department contact Gene Heighton at 547-6900.

SEE BACK COVER OF HIFI SUPPLEMENT FOR OTHER BRANDS MART SPECIALS

KITS

Continued from page 6

help uncover weaknesses in the instruction manual. That's gone the way of male chauvinist piggery now, but the manuals still are carefully checked and worked over until they cost about as much as the labor to produce the kit might have. Maybe this helps explain why kits are not the out-and-out bargains they often are claimed to be.

Thus, whether a kit works or not after you have put it together depends on you more often than on the kit itself. Human error is the biggest cause of kit failure. Here are a few rules for kit-builders which should make many of the more common errors unlikely:

• *Read and follow the instructions.* Sound simple-minded? There is more damn-foolishness exercised in kit construc-

Continued on page 39

Heathkit and Dynaco are known to all, but have you heard of Audionics? Didn't think so. Here's a beginner's list of hi-fi kit-makers with their addresses and a little data on what they make. In alphabetical order:

• *Aries* Inc., 119 Foster St., Peabody, Mass. 01960. Studio music synthesizer kits are the big thing here, but the outfit also sells smaller items, like digital clocks.

• *Audionics*, Inc., 8600 NE Sandy Blvd., Portland, Ore. 97220. Loudspeakers — both bare and in kits including enclosures — plus electronics like SQ decoders for higher-than-average-quality quad.

• *Dynaco* Inc., PO Box 88, Blackwood, N. J. 08012. Tuners, power amps, preamps, loudspeakers and a few items like "ambience generators." This company, because its products are discounted, probably offers more value per dollar than any other hi-fi manufacturer.

Who's Selling What?

• *Gately Electronics*, 57 West Hillcrest Ave., Havertown, Pa. 19083. A wide line of mixers, equalizers, and even a reverb unit for pro and semi-pro recordists. Very high quality stuff, priced to suit.

• *Heathkit*, PO Box 167, St. Joseph, Mich. 49085. The king of the kit-makers; offers one of everything including a lot of stuff nobody really needs. Generally high in price compared to quality, except for a few products in its line, and never, ever discounted. For smart shoppers and first-timers only.

• *Klipsch and Assoc.*, PO Box 688, Hope, Ark. 71801. Not a pure kit-maker, although the giant and costly K-horn is available in unfinished form at almost $500 savings. Thought you deserved to know.

• *Old Colony Sound Lab*, PO Box 243, Peterborough, N.H. 03458. Vendor of offbeat kits like electronic crossovers, metering systems, power supplies and other kits for improving existing hi-fi components, plus other more familiar things such as equalizers and amplifiers. To appreciate this outfit, you should subscribe to *The Audio Amateur*, a quarterly published out of the same stable through PO Box 176 in Peterborough. Well worth it to kit-builders and construction types generally.

• *PAIA*, 1020 Wilshire Blvd., Okalhoma City, Okla. 73116. Synthesizers mostly, but also some audio gear — especially for roady types. Some bizarre stuff . . . .

• *Ruxton Electronics*, PO Box 30312, Santa Barbara, Calif. 93105. Speaker kits of unknown quality (their having never been reviewed) at a claimed saving of "up to 50 percent."

• *Southwest Technical Products Inc.*, PO Box 30240, San Antonio, Texas 78284. Probably the hottest line of electronic kits since Dyna and Heath started, and some very low-price, high-performance amps and preamps. Other things too, like equalizers, and even a computer if that's your wish.

• *Speakerlab*, 5500 35th NE, Seattle, Wash. 98105. Loudspeaker kits, including a very near approach to the Klipschhorn. Usual bookshelf-sized product combines "West-Coasty" sounding horn mid-range and high frequency drivers with New England's acoustic suspension woofer principle. Unmounted speakers, too.

This isn't anything like a complete list of kit vendors; there are lots more post office boxes left in the US; but these are among the better known. Their catalogs are great wish books.

for sale

Selling, Swapping or Seeking HiFi Equipment?

The Boston Phoenix classifieds will do the job for you.

$3.00 for 4 lines (30 characters)
$1.50 each additional 2 lines
$1.50 per headline (18 characters)

BOSTON PHOENIX CLASSIFIED DEPT.
536 Comm. Ave., Boston, Mass. 02215

(See Our Coupon in Section II)

The next logical step

ALLISON:ONE $360*

Twenty years ago Edgar Villchur, with his revolutionary acoustic suspension design, demonstrated the advantages of treating the woofer and its enclosure as a system rather than separate components. Today, nearly all loudspeakers embody this concept. Roy Allison (a professional associate of Mr. Villchur for many years) has now extended the "system" one logical step further, to include the listening room itself. The result is an improvement by one order of magnitude in the accuracy of the reproduced sound field.

Descriptive literature on ALLISON loudspeaker systems which includes technical specifications is available on request.

ALLISON ACOUSTICS INC.
7 Tech Circle, Natick, Massachusetts 01760

*Higher in West and South

See and Hear
The Allison Loudspeaker Systems at:

Tweeter etc.

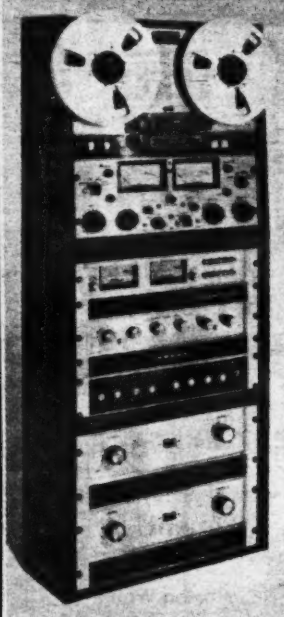
874 Commonwealth Ave.
Brookline * 738-4411

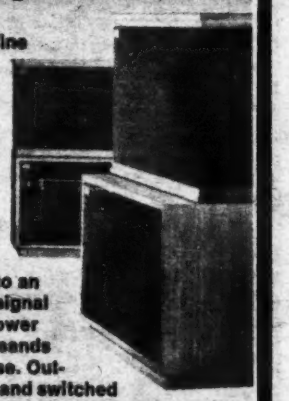
102 Mt. Auburn St.
Harvard Sq. * 492-4411

Chestnut Hill Mall
964-4411

849 Belmont St.
Brockton * 583-5146

Could the ultimate system be all Crown?





It depends on how you define "ultimate". But Crown may be the only top-quality, state-of-the-art manufacturer whose components could build a complete ultimate system.

For instance: A CX-824 tape deck, world-renowned for reliable performance. Connected to an IC-150 pre-amp. With the signal amplified by a DC-300A power amp, proved in many thousands of hours of professional use. Output controlled, monitored and switched by an OC-150. Possibly a VFX-2 for personal control of crossover points. And sound faithfully reproduced by ES-212 electrostatic speakers.

All Crown. We think *that* system would be somebody's ultimate. Certainly ours. Maybe yours.

Write us today for the name of your nearest Crown dealer. He'll talk to you — ultimately.

When listening becomes an art,

crown
Box 1000, Elkhart IN 46514

See the fine Crown products at:

TECH HIFI
870 Comm. Ave. • Boston
240A Newbury St. • Boston
38 Boylston St. • Cambridge
279 Main St. • Worcester
253 Triangle St. • Amherst
375 N. Montello St. • Brockton
Hanover Plaza • Hanover
Providence & Warwick R.I.

EARDRUM
16 Eliot St. • Cambridge
468 Comm. Ave. • Boston
Rt. 3A • Burlington

WALTHAM CAMERA
363-367 Moody St. • Waltham

CENTRE MUSIC
18 Main St. • Framingham

ATLANTIS SOUND
38C Brattle St. • Cambridge
1092 Comm. Ave. • Allston
811 Boylston St. • Boston
248 Worcester Rd. • Framingham
10 Sylvan St. • Peabody
328 Main St. • Worcester

E.U. WURLITZER
360 Newbury St. • Boston

TERRY HANLEY AUDIO SYSTEMS
329 Elm St. • Cambridge

AUDIONICS
790 N. Main St. • Providence, R.I.

TED HERBERT'S MUSIC
934 Elm St. • Manchester, N.H.

NANTUCKET SOUND
North Dartmouth Mall • North Dartmouth
Swansea Mall • Swansea
Cape Cod Mall • Hyannis

OLDE COLONY STEREO
32 Copeland St. • Quincy
Farmers Mkt. Plaza • Hanover
Rt. 3A • Cohasset

Tools: What You Really Need

You *can* assemble a hi-fi kit with only a jack-knife and soldering iron, but it is easier, saner and safer to equip yourself with the right tools before starting.

Assuming that you are building an electronic kit (as opposed to a speaker) the basic lineup will include: soldering iron or pencil (not a soldering gun), wire-cutters, wire-strippers (for removing insulation), standard and Phillips head screwdrivers in several sizes (the number will vary with the kit), pliers.

This is the minimum list for competent, comfortable work. The soldering iron should be powerful enough to melt the solder quickly and thus to stay on the joint for the shortest time. Wire-cutters and strippers often are combined in a single tool costing about the same as a pair of wire cutters alone. If you plan to build only a few kits, buy this combination. Screwdrivers are something you can never have enough of, so invest in a set. If you don't use them on the kit, you will sooner or later attack the Volks or household repairs with them. The pliers are to hold nuts sometimes hidden at the other end of screw-headed bolts widely used in electronic kits.

Going beyond the minimum, you will often find use for these tools: nut drivers or miniature socket wrenches, soldering gun, a cheap volt-ohm meter, bench vice, hack saw, metal file, electric drill and bits, taps, cable cutters and propane torch.

Nut drivers are like screwdrivers with nut-shaped recesses in their tips. Very useful, although not quite so much so as miniature socket wrenches, which do the same job and include ratchets, U-joints, extensions and other items needed to reach into the obscure innards of some kits.

Soldering guns are help in situations where large pieces of metal have to be joined or where wires must be soldered to large plates that soak up heat readily. If you are, say, attaching a ground-wire to a large metal chassis, chances are that the soldering iron alone won't yield enough heat to make the solder flow. It's at this point you bring up the big guns. Sometimes even the gun isn't enough and you need the propane torch mentioned above — a miniature unit, of course.

A $10 investment in Radio Shack's cheapest volt/ohmmeter can save you literally hundreds of dollars later. Use it to spot short circuits, to check for proper contact, to see whether the resistances in a unit are right before you plug it in, and whether the voltages are correct afterward. Better out a ten-spot than smoke and agony in the listening room.

As for those other items, like vices, saws, files, taps, etc., I have needed all of them at one time or another, usually to correct an error in the kit company's layout or metal bending. Note that heavy artillery like this will be needed less often with Dynaco and Heathkit units than with other products.

Continued from page 38

tion than in almost any area short of radical politics. The folks who wrote the instruction manual want "that" wire cut to "that" length for a reason. Do it their way.

• *Use the right tools.* (See box, "Tools: What you Really Need")

• *Be methodical.* This is another plea for reason at the workbench; your kit is more apt to work if you double-check things like resistor values, capacitor values, and circuit board locations, carefully, both before *and* after you solder things together. Then have a friend check *your* work.

• *Work in short stages.* The natural tendency is to work hard and fast to get the kit completed and on the air. The natural tendency is to court disaster. The faster you try to work the sloppier your work will be. The longer you work at a stretch, the more tired you'll get, the more apt you'll be to make mistakes, and, depending on the kit, you need to make only one baddy to send the whole thing up in smoke.

• *Don't work when tired.* For the same reason, try to take frequent breaks and to stop before you are pooped. Tired people make mistakes.

• *Build a simple kit first.* If you are building a whole system out of kits, build the power amplifier first. Not only is the power amplifier usually simpler to construct, but also many of the parts are heavier, and can withstand more heat and rough treatment. Tuners are next in complexity, and the last item you should try to build (especially as a first kit) is a preamp or receiver. Even the experienced (and therefore cynical) kit-builders tend to mutter "never again" as they wire preamp selector switches. If you want to keep your childlike optimism, don't start your kit career with a preamp.

This rough guide will help you avoid most of the first-timer's pitfalls. But even if you are literate, patient and disciplined, you still may be a klutz at soldering. Without this basic skill, you can't expect success. Fortunately, soldering is mostly a matter of picking the right equipment and then using it properly; practice can cure almost any ineptitude on your part.

Soldering

Instruction manuals usually include soldering instructions up-front — in that introductory section people never seem to read. No sense in repeating it here; *you* read it and practice what it preaches. Additionally, though, here are a few soldering tips.

• *The idea of soldering is to get in and get out fast.* Too much heat applied too long can destroy a circuit board and the component you are soldering into place. Oddly enough, one way almost to assure disaster is to use too low-powered a soldering pencil.

Too cool a tool will have to rest on the joint for a long time before heating it to the point where solder melts and the electrical joint forms. While all this time is passing, the heat of the tip is running merrily up the lead being soldered — perhaps roasting a transistor, or melting a capacitor.

You might try using a pencil rated at about 45 watts for printed-circuit wiring (the most common type). With a one-eighth inch diameter pointed tip running at more than 700 degrees Fahrenheit, this iron will liquefy solder fast, and the solder will flow quickly over the joint, carrying the heat of the tip with it — and the job is done. Often the act takes less than a second; thus while the tip may be somewhat hotter than many kit companies recommend, it isn't near the joint as long as a cooler iron would be, and fewer fried components result.

• *Get a soldering pencil* with an iron tip. Copper tips corrode and the corrosion — acting like insulation — causes a drop in effective tip temperature.

• *Keep your iron clean.* Use a damp sponge (not steel wool — never!) to wipe off dirt and rosin leavings; this cleaning should be done before every use. Again, iron tips seem easier to keep clean.

• *Pick solder carefully.* Not all kit-makers supply solder and many don't supply enough, so there will come a time when you'll have to buy your own. Here's what to get: 60/40 tin-lead, rosin-core solder: this is the only type you should use; fortunately it is widely available. Shun acid core solder; using it will damage your kit, and void its warranty. Even the diameter of the solder is important, and thinner is generally better because it heats and melts faster (remember the quick in, quick out rule). For best results on today's printed circuit board equipment, use solder which is .028 inches in diameter (that's size 15 or wire gauge number 22). This is thin stuff; thicker stuff costs less per foot, but nothing beats skinny solder for printed circuit use, or for most other electronic applications.

• Finally, if you are taking your time and doing a really thorough job, you might use steel wool to wipe off the crud applied to the leads of resistors and capacitors. Although these leads are already solder-coated, some seem also to be covered with wax to prevent corrosion, but the wax is like trading one evil for another. Gently remove it with the steel wool and your solder join is likely to be sure fire. For that matter, it's sometimes good to burnish printed circuits gently to remove corrosion on them too; use a pencil eraser for this.

Is That Kit Really a Bargain?

You'll probably buy a hi-fi component for its unique combination of features rather than purely on price. Still, one of the selling points of kit-pushers which is hard to dissipate is the kit's supposed value for money; the rationale is that you pay less, contribute some sweat, and get more performance than you would have if you had bought an assembled unit.

This is not always so, and we can show it by a simple exercise in comparison shopping. Compare Heathkit's AR-1500A receiver, its 60-watt/channel, top-of-the-line model with seven already assembled units in the same power category. Like the Heath, all are AM-FM units, but each has some features its competitors do not.

Model	Heath AR-1500A	Kenwood KR-7400	Marantz 2250	Nikko 9090	Onkyo TX-670	Pioneer SX-838	Sansui 881	Scott R-77S
Price	$429.95	519.95	499.95	499.95	519.95	499.95	529.95	499.95
Price Difference		+90	+70	+70	+90	+70	+100	+70

So far, the kit leads on a dollar basis, but there's one thing the Heathkit catalog doesn't mention: Heathkits are almost never discounted. On the other hand, assembled equipment almost *always* is, sometimes by as much as 20 percent to 30 percent. This changes the picture drastically:

Model	Kenwood KR-7400	Marantz 2250	Nikko 9090	Onkyo TX-670	Pioneer SX-838	Sansui 881	Scott R-77S
Saving vs. Heathkit							
with 20% discount	$13.99	29.99	29.99	14.03	29.99	5.99	29.99
with 30% discount	65.99	79.99	79.99	65.98	79.99	58.99	79.99

Thus, the old saw about trading some of the sweat of your brow for a component of higher quality at a low price looks shaky at best. Simply by shopping for lower prices it is possible to beat the cost of a kit. Consider also that in buying an assembled unit you are saving the labor you would have put into the kit's assembly, plus the risks anyone takes who tries to assemble a kit himself.

So if you are trying to avoid being burned — whether on price or with a soldering iron — select the features and power you want and then shop for the best price. You might wind up with a kit, but the economics are against it.

eardrum is pleased to announce the addition of the Ambient Loudspeaker line to our showrooms.

The Ambient Model 55

Specifications

Driver Complement	Size
1" Dome Tweeter 4" Midrange 10" Acoustic Suspension Woofer	30" high 10" deep 15" wide
Power	**Gimmicks**
25 watts min. 150 watts max.	None

The AMBIENT Model 55 represents the highest evolution in dynamic transfucer research and design. Each component and design variable has been thoroughly researched and matched in order to produce a loudspeaker system that remains utterly faithful to its input.

The Model 55 is a three driver, three-way system which maintains wide dispersion, precise imaging, full range frequency and power response, and excellent transient performance. Its extremely high degree of accuracy enables it to virtually disappear when fed good program material through high quality electronics.

The Model 55 and other Ambient Loudspeakers may be seen and heard at the eardrum location near you.

eardrum

Harvard Sq 16 eliot st 864-1155

Burlington rt 3a (by valuehouse) 273-1105

How to get the most performance from the cassette deck you buy from Tech Hifi.

A good quality cassette deck enables you to make your own high fidelity stereo recordings for about half the amount that you'd pay for a record album. And about *one third* of what you'd spend on a pre-recorded tape.

And Tech Hifi can provide you with an excellent, Dolby-equipped, cassette deck for as little as $200. (Or as much as $500). Choose from respected manufacturers like Advent, Pioneer, Tandberg, Teac and Technics.

But even the best cassette deck you can buy will deliver dissapointing performance if you put an inferior cassette into it. One that adds unwanted noise, restricts frequency response, or jams up (inevitably, right in the middle of a never-to-be-repeated FM broadcast).

So Tech Hifi recommends that you use Maxell cassettes with the deck you buy from us. They're engineered with the same precision as the tape machines themselves. Maxell cassettes don't jam; superior materials, like carbon-teflon slipsheets and stainless steel spindles, assure a life-time of precision performance.

Maxell puts two different kinds of tape into their cassettes. Maxell LN (Low Noise) tape is about as good as you can get. Except for Maxell UD (Ultra Dynamic) tape. The UD tape gives you 2 dB better signal-to noise characteristics, and frequency response that extends to the limits of human audibility.

Maxell cassette are every bit as good as the highest-quality decks. So you'll actually realize the potential built into the deck *you* own.

Could you be happy with anything else?

maxell®

240A Newbury St.. 870 Commonwealth Ave.. **BOSTON** / 38 Boylston St.. 182 Massachusetts Ave.. **CAMBRIDGE** / Route 9. **FRAMINGHAM** / Route 1. **DEDHAM** / 835 Southern Artery. **QUINCY** / 352 Main St.. **STONEHAM** / 667 Main St.. **WALTHAM** / 279 Main St.. **WORCESTER** / 186 Main St.. **NORTHAMPTON** / 253 Triangle St.. **AMHERST** / Hanover Plaza. **HANOVER** / 375 North Montello St.. (Route 28) **BROCKTON** / Main St.. **HANOVER, N.H.** / Nashua Mall Extension. **NASHUA, N.H.** / Stores also in Rhode Island. Connecticut. Vermont. New York. New Jersey. Ohio. Pennsylvania and Michigan.